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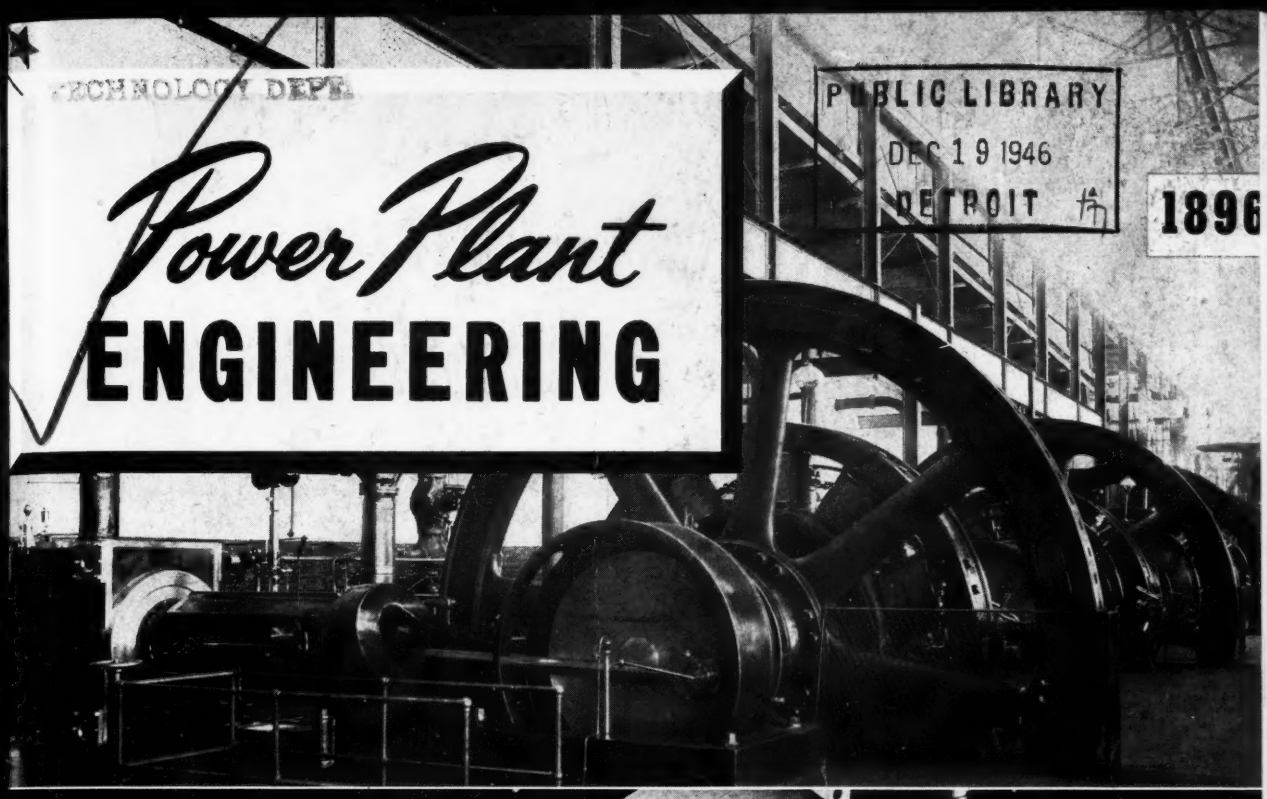
Power Plant ENGINEERING



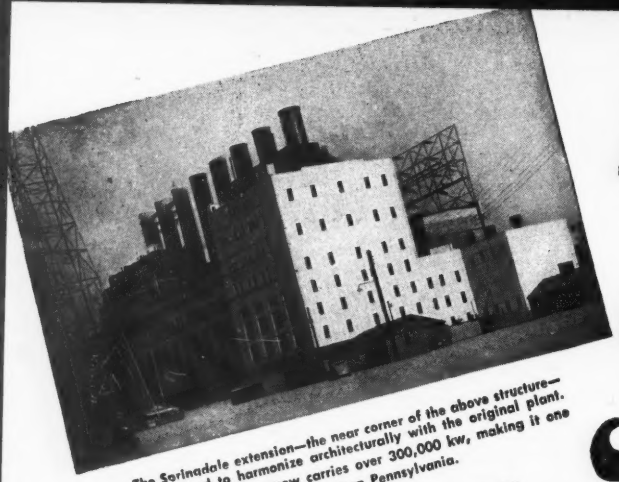
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

DECEMBER • 1946

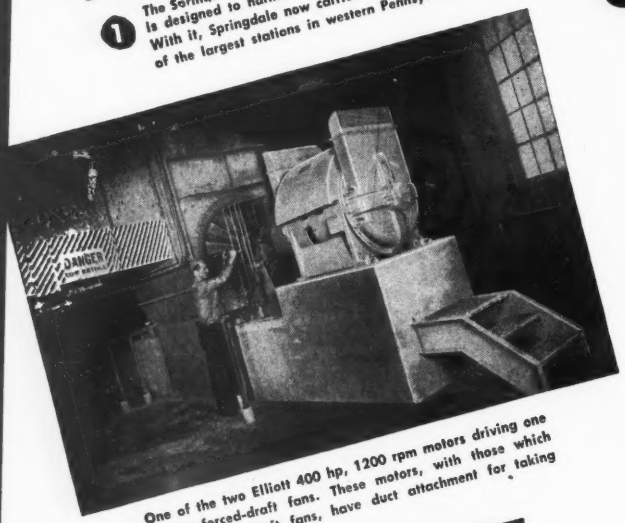
50th Anniversary Issue

FIRE PROTECTION • DANGEROUS ELECTRIC CURRENTS • MILL CREEK • 1000 KW PACKAGED PLANT • DISSOLVED OXYGEN MEASUREMENTS • YEARLY INDEX 187-192 • CONTENTS PAGE 5

At Springdale vital motor



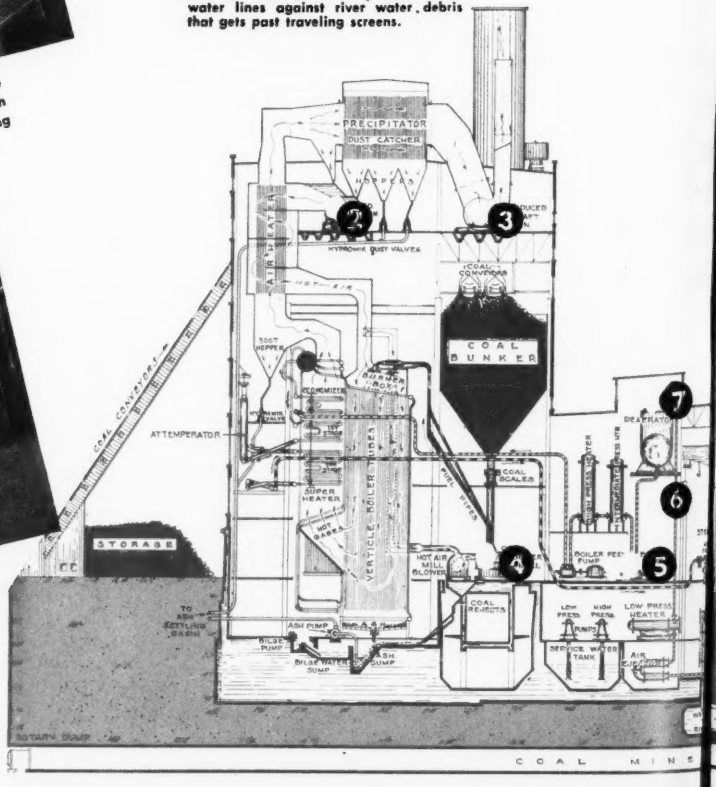
1 The Springdale extension—the near corner of the above structure—is designed to harmonize architecturally with the original plant. With it, Springdale now carries over 300,000 kw, making it one of the largest stations in western Pennsylvania.



2 One of the two Elliott 400 hp, 1200 rpm motors driving one of the forced-draft fans. These motors, with those which drive induced-draft fans, have duct attachment for taking filtered air from outside.

3 One of the two Elliott 700 hp, 720 rpm motors driving induced-draft fans. The windings are especially impregnated for boiler-room conditions.

7 In addition to motors by Elliott, the Springdale extension has also selected a 1,000,000-lb-per-hr vertical deaerating feedwater heater and an evaporator preheater, both Elliott-built. In the plant is an Elliott 750,000-lb-per-hr deaerator which has ably served since 1924. Several Elliott twin strainers protect service water lines against river water debris that gets past traveling screens.

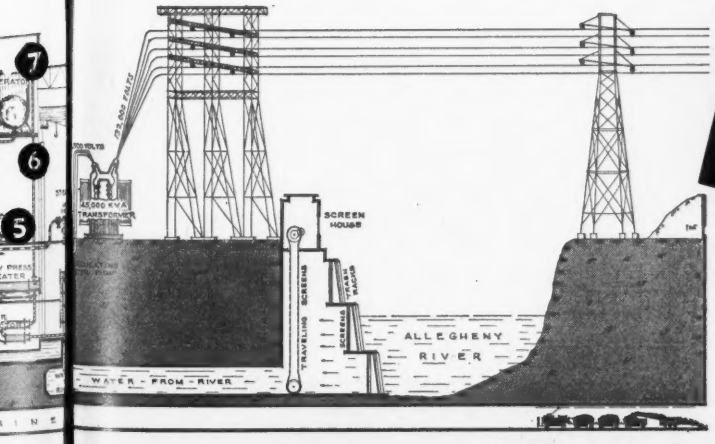


Elliott

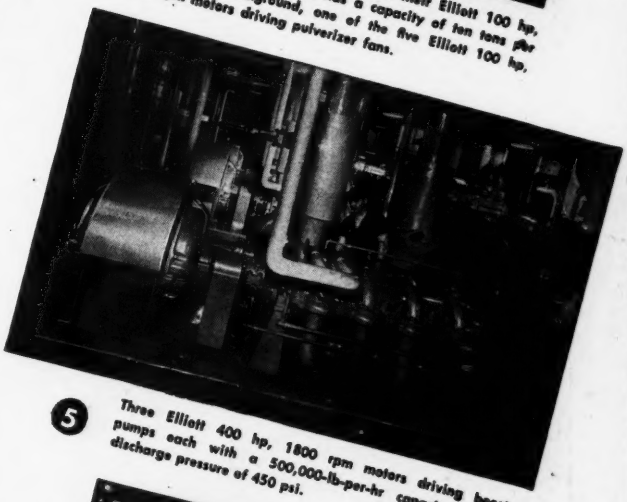
by Elliott

The new 65,000-kw addition to the Springdale Station of the West Penn Power Company, uses a number of Elliott motors for vital drives. The motors are all custom-built, with some unusual features. All are of the squirrel-cage induction type, in capacity ranging from 50 hp to 700 hp.

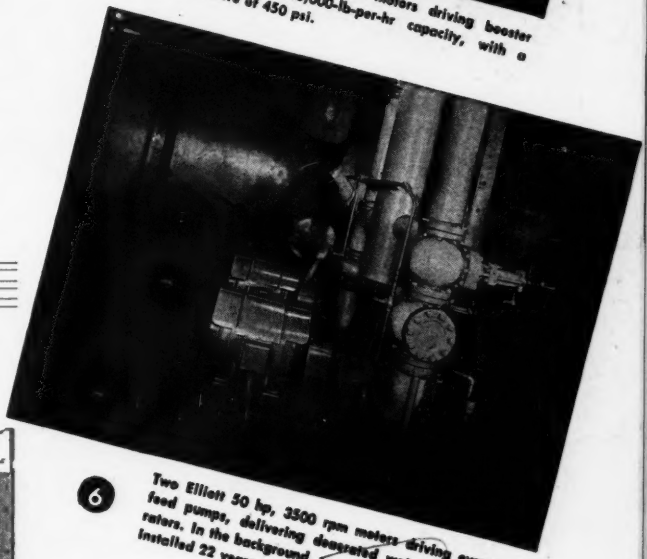
These motors are built, with traditional Elliott attention to detail, for the work they have to do and the conditions under which they do it. They are as reliable as careful engineering plus superlative workmanship can make them. Details of Elliott principles of motor construction are available in Motor Bulletins, on request.



4 Line-up of five coal pulverizers, with their Elliott 100 hp, 600 rpm motors. Each unit has a capacity of ten tons per hour. In left background, one of the five Elliott 100 hp, 1800 rpm motors driving pulverizer fans.



5 Three Elliott 400 hp, 1800 rpm motors driving booster pumps each with a 500,000-lb-per-hr capacity, with a discharge pressure of 450 psi.



6 Two Elliott 50 hp, 3500 rpm motors driving evaporator feed pumps, delivering deaerated water to all evaporators. In the background, an Elliott deaerator which was installed 22 years ago.

L-768

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Power Plant ENGINEERING

December, 1946

VOLUME 50—NUMBER 12

Cover: Photographs show contrast between large Corliss engine generators operating in 1896 and modern turbine generating unit.

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1896 50TH ANNIVERSARY 1946

CELEBRATING 50 YEARS OF SERVICE TO THE POWER INDUSTRY

Jenkins PRACTICAL PIPING LAYOUTS 17

How to plan a HOT PROCESS — LIME and SODA WATER TREATMENT SYSTEM

This feedwater treatment system is typical of applications where operations provide exhaust steam and large quantities of water must be treated.

Raw water is admitted through a liquid level controller to sedimentation tank, then passed through a vent condenser to cut the amount of vapors escaping and conserve as much heat in the steam as possible. Lime and soda mixed into a slurry are fed into tank and treated water is decanted off top.

In normal operations with valves M, P and R closed, the water flows through valve G to header feeding the filters, and then, by means of individually-controlled valves J, to filters in service. Next, the water passes through filters and open valves K to filtered water header.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

Copies of Layout No. 17, enlarged, with additional information, will be sent on request . . . also future Piping Layouts. Just mail coupon.

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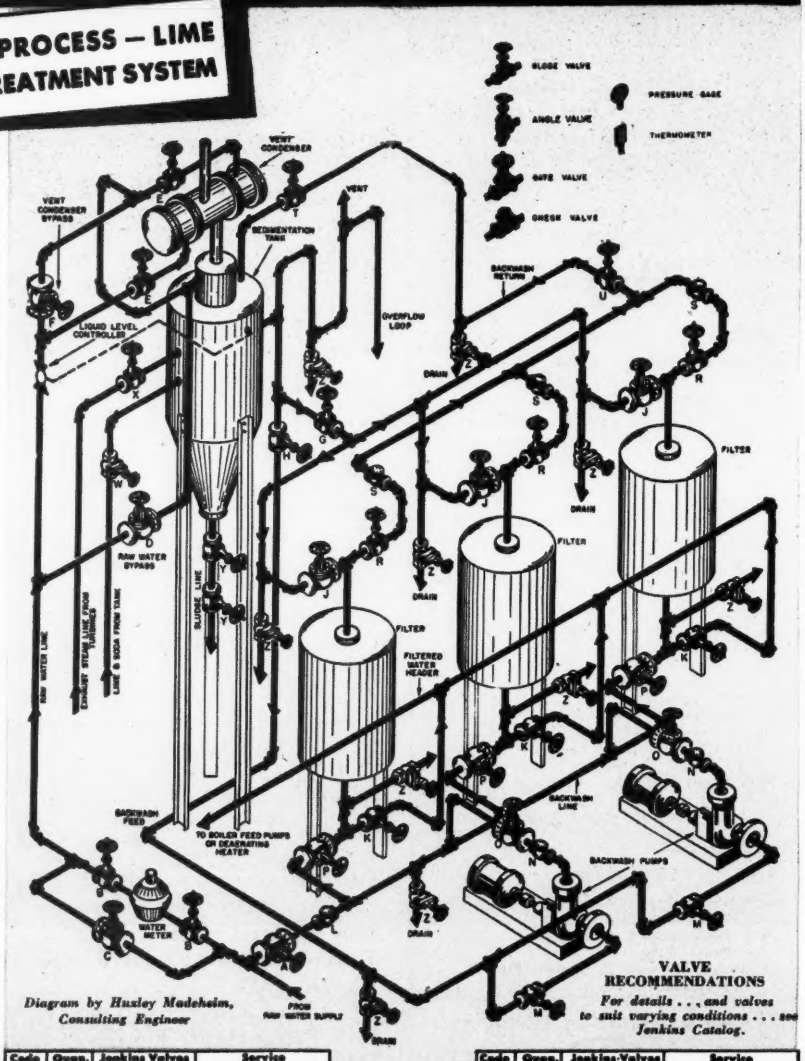

Diagram by Huxley Madeheim, Consulting Engineer

VALVE RECOMMENDATIONS

For details . . . and valves to suit varying conditions . . . see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	1	Fig. 142 All Iron Globe	Raw Water Control for Backwash
B	2	Fig. 100 All Iron Gate	Raw Water Meter Shutoff
C	1	Fig. 142 All Iron Globe	Meter By-Pass
D	1	Fig. 142 All Iron Globe	Manual Raw Water Admission
E	2	Fig. 100 All Iron Gate	Vent Condenser Shutoff
F	1	Fig. 142 All Iron Globe	Vent Condenser By-Pass
G	1	Fig. 100 All Iron Gate	Treated Water Feed to Filters
H	1	Fig. 100 All Iron Gate	Treated Water Feed to Backwash Pumps
J	3	Fig. 142 All Iron Globe	Treated Water Control to Individual Filters
K	3	Fig. 100 All Iron Gate	Treated Water Shutoff to Filtered Water Header
L	1	Fig. 293 All Iron Check	Prevent Backwash Flow into Raw Water

Code	Quan.	Jenkins Valves	Service
M	2	Fig. 100 All Iron Gate	Backwash Pump Suction Shutoff
N	2	Fig. 295 All Iron Check	Backwash Pump Discharge Check
O	2	Fig. 142 All Iron Globe	Backwash Pump Control
P	3	Fig. 142 All Iron Globe	Backwash Control to Individual Filters
R	3	Fig. 100 All Iron Gate	Backwash Shutoff Individual Filters
S	3	Fig. 295 All Iron Check	Prevents Back Feed from Sedimentation Tank
T	1	Fig. 100 All Iron Gate	Backwash Ret. Shutoff at Sedimentation Tank
U	1	Fig. 100 All Iron Gate	Backwash Return Shutoff at Filters
W	1	Fig. 750 All Iron Globe	Lime & Soda Feed Control
X	1	Fig. 431 I.B.B.M. Gate	Exhaust Steam Shutoff
Y	2	Fig. 100 All Iron Gate	Sludge Line Shutoff
Z	10	Fig. 750 All Iron Globe	Drains

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Front Lines

STEAMBOATIN' is on the way back. Excursion and cargo boating are being revived not only on the Mississippi River but also on the Ohio and Tennessee. A new fleet of steamers, carrying 300 passengers each, will operate excursion schedules from Knoxville—where the Tennessee joins the Ohio—to Paducah. The Tennessee Waterways Conference, representing all the interests in the Valley, is fostering this and other projects. In addition, some of the historic old steamship lines are coming back. The *S.S. Gordon C. Greene*, long famous as the flagship of the Greene Line, has been refitted and streamlined and is now operating out of Cincinnati all the way down to New Orleans. Likewise the old *Golden Eagle* of the Eagle Packet Co., still sound and seaworthy, has been given new engines and completely modernized, and is sailing the Ohio and Mississippi. Other cruises in both directions are being scheduled from St. Louis. All the towns along the way that once were stopping places for the show boats are sprucing up to welcome a flood of tourists, according to *Ethyl News*.

IN CANADA many paper mills and other industries use electric boilers supplied with power from the nearby hydro plants. Such electric boilers are essentially nothing more nor less than oversized immersion heaters. These electric boilers require very little maintenance work but once in a while it is necessary to do some work on the electrodes. The way in which metallizing has been used at plants of the Shawinigan Water and Power Co. for this purpose is told in considerable detail in an article in the July 1946 issue of *Metco News*.

A PRIVATELY OWNED electric company and a Rural Electrification Administration co-operative have recently worked out a practical and workable agreement for development of an entire area. The organizations involved are the Washington Water Power Co. of Spokane, and the Inland Empire Rural Electric, Inc., one of the largest REA co-operatives in the Northwest. Under the agreement recently reached, rural applicants served by both organizations will be served by whichever of the two groups can make the necessary extensions with the least outlay of capital. This idea is a direct outgrowth of the coordination of the privately owned, municipally owned, Federal and REA power systems during the war when they were all interconnected and pooled their resources to serve their areas most effectively. See *Power Plant Engineering*, October, 1945.

BY A STUPENDOUS EFFORT of the will, we hereby firmly refrain from making the various corny cracks that come so easily to mind in reading the following announcement: "New systems of air conditioning, acoustic equipment and lighting are to be installed in the Senate and House Chambers of the United States Capitol so that it will be completely modernized prior to January, 1948. This modernization is intended to improve working conditions in Washington."

RUBBER COATINGS for the protection of steel open up new horizons. Paratex metal coating, a rubber base coating for metal surfaces, is now back on the market. It has been used for protection of transmission towers, outdoor steel tanks, and many other types of steel structures. It is designed to be fast drying, resistant to ultraviolet light, highly resistant to chemicals and proof against various solvents, and, it is claimed, requires less frequent application.

EXPERIMENTS with transparent plastic models of machine bearings are revealing "inside information" that may result in more powerful motors for the nation's factories. The plastic models are enabling scientists to look inside a moving bearing and see what is happening to the lubricating oil—something never before possible, according to John Boyd, Westinghouse research engineer, who developed the novel technique. Oil, colored with a red pigment, is fed into the bearing model and the lubrication effectiveness quickly is apparent. Engineers know at once whether the seals work properly, whether the oil passages are enabling a proper flow of the lubricant, and whether the relief points are located correctly. All this formerly had to be determined very largely by trial and error.

THE STERN of the *Sackett's Harbor* was used as a permanent electric power plant at Anchorage, Alaska. *Sackett's Harbor* was a 16,000-ton tanker. Last March she broke in half off Alaska during a heavy storm. Her crew was rescued without casualties and when the storm abated, the tanker's skipper and nine men reboarded the stern section and brought it to land safely under the ship's engines. Projects for fitting a new bow on the vessel were abandoned because of the high cost. Meanwhile, citizens of Anchorage, Alaska, asked to be permitted to use the engines of the vessel for a power plant. A tug towed the stern to the city and it has been supplying power for several weeks.

ALREADY the atomic energy business is actively operating in the form of Tracerlab, Inc., a new company founded by William E. Barbour, Jr. This organization has three functions: 1. Planning, design and manufacture of precision electronic instruments for measuring and evaluating radioactivity; 2, analysis and synthesis of radioactive compounds, and 3, development of practical application of radioactive tracer techniques to industry and agriculture, and other business. Already this organization has filled a number of orders for its "Autoscaler," an instrument for measuring radioactivity by timing a predetermined number of radioactive impulses. The company is also working on several commercial projects in which radioactive chemicals will be used as tracers to check the progress of a chemical or industrial manufacturing process. Devices for detection and measurement of radioactivity in the medical field, for use in tracer chemistry in diagnosis, are also being planned.

SHEET-METAL bulletin board, on which small pieces of magnetized metal are used as thumb tacks, has recently been installed in his laboratory by E. J. Freeman, professor of Industrial Engineering, at Clemson College, South Carolina. "It saves considerable wear and tear on the thumbs," says Professor Freeman.

A $50,000,000 research and engineering center is being planned by Ford Motor Co. to be located on a 500-acre tract west of Dearborn Inn. The project will take some eight years to complete. Because of the company's plans for new models, the first research units to be built will be the Body Styling and Dynamometer buildings. The company feels that the most intensely competitive market in automotive history is ahead and realizes that leadership in the transportation field will depend very largely on technological advances. Another recognized need is that for human engineering—scientific research into the relations between various groups of the industrial family and into the human preferences and requirements of consumer groups.

VARIOUS PUBLICITORS (press agents to you) have been bombarding us recently with comments about the possibility of constructing an East-and-West compass; that is, a compass in which the needle would point East and West instead of North and South. This idea seems to arise out of the announcement that a new magnetic material known as Silmanal, a silver, manganese, aluminum alloy, has been developed, which can be magnetized widthwise instead of lengthwise. If that is the case, then it is conceivable that a bar of this material freely suspended in the earth's magnetic field would point crossways of the field instead of lengthwise of the field. We can readily understand that a metal that will magnetize crosswise instead of lengthwise can be very useful in a great many electrical devices. But we are completely bewildered when we try to imagine why it will permit any improvement in the conventional compass. Perhaps Front Lines readers know and can explain to us what the advantages of an East-and-West compass might be.

CONSTRUCTION of underwater power stations in river dams is described as an unconventional technical development in the German electric supply industry during the war, in a report now on sale by the Office of Technical Services, Department of Commerce. The 140-page report was prepared by H. Neubrunn for the British Intelligence Objectives Sub-Committee. The underwater power plants are of the low-head type, according to the report. The turbine generators are specially designed so that the rotor carries the turbine blades. Water flows around the stator of the generator for efficient cooling. The electric part of the set is water tight. One such power station was constructed on the Persante River in Eastern Germany and another on the Iller River

HOW WOULD YOU like to make a million dollars? How would you like to win the girl or get to speak at Kiwanis luncheons? How would you like to have Don Ameche portray you in a film biography? If that kind of life appeals to you, says Billy Rose in his regular newspaper column, here is what to do. Join the new foundation he is setting up—The F.F.I.S.P.N.A.B.—Foundation for Inventing Stuff People Need Awfully Bad. All you need is a screwdriver and a faraway look in the eye. Then turn your attention to these important problems. Devise a gadget so that no matter what time you walk into a movie the feature is just beginning. Then figure out a way to make the feature good. Or try modernizing the automobile. What good is a 100 mile an hour glass-chromium dream wagon when the jalopy ahead won't go over 20? Or how about an eraser key for typewriters? It's time, says Billy, that somebody made something for stenographers besides passes. In your spare time, you might revolutionize the restaurant business by inventing some new food combinations, such as clam chowder with clams, a fresh fruit drink with fruit, and chicken chow mein with chicken. If you happen to be one who thinks this might conceivably be a better world, try this one: Instead of the frightening firecracker which will eliminate civilization, try to work out a civilization that will eliminate the firecracker. Come up with that one and Mr. Rose will get you two weeks in vaudeville.

TROUBLE BEGINS TO SHOW UP ABOUT HERE

A turbine oil that is not specially refined and fortified begins to suffer from the ever-increasing effects of its own breakdown. The products of oil oxidation serve to speed the oxidation of *more and more* oil. No wonder ordinary lube oil quality drops rapidly!

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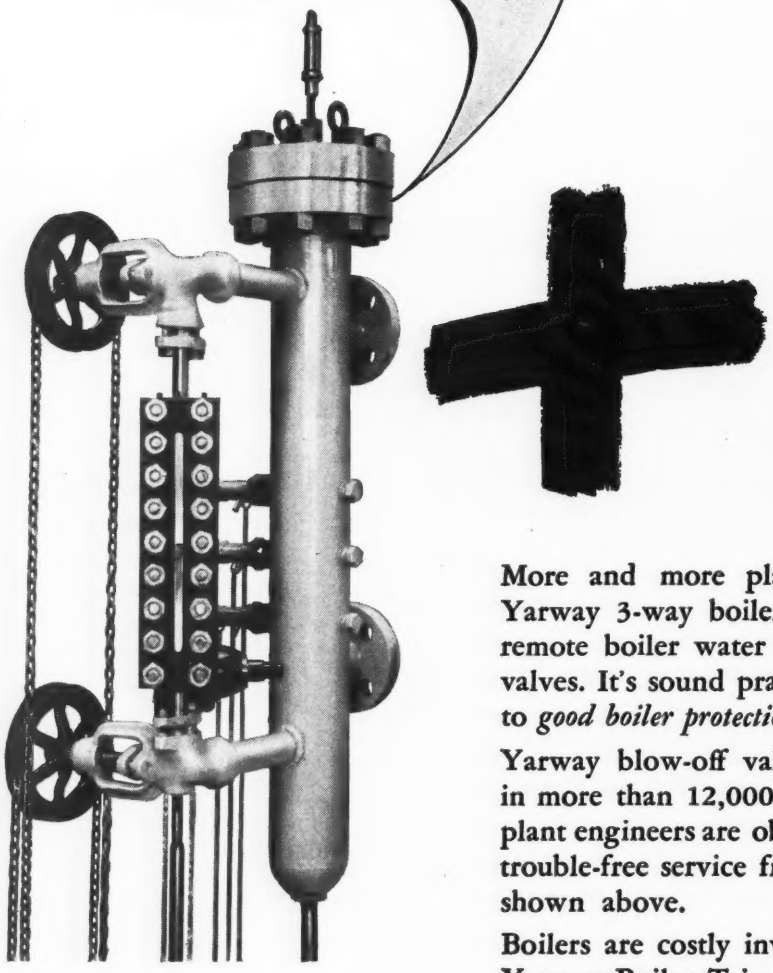
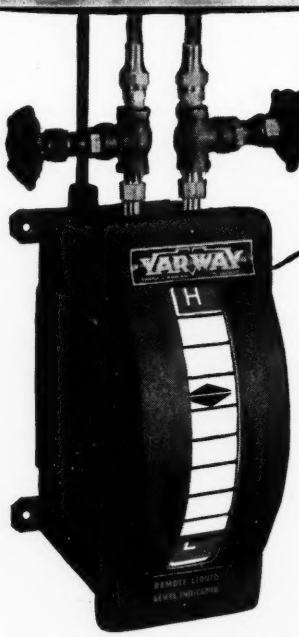
Alarm mechanism uses balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous changes from normal water level. Flat glass pressure-sealed gage insert is mica protected and has spring cushion which prevents excessive strain on glass. Types for pressures to 1500 psi. See Bulletin WG-1810.



Yarway Remote Boiler Water Level Indicator

Brings hard-to-see overhead gage readings down to eye level, on instrument panel or any other convenient location. Always accurate because it's operated by the boiler water itself. Indicating mechanism is never under pressure. *There are no stuffing boxes.* Action is instant, constant and practically frictionless. Moderate in cost... easy to install. See Bulletin WG-1821.



More and more plants today are insisting on Yarway 3-way boiler trim — columns and gages, remote boiler water level indicators and blow-off valves. It's sound practice, too, because it adds up to *good boiler protection.*

Yarway blow-off valves are standard equipment in more than 12,000 boiler plants today . . . and plant engineers are obtaining the same dependable, trouble-free service from other Yarway boiler trim, shown above.

Boilers are costly investments. Protect them with Yarway Boiler Trim.

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114 Mermaid Avenue, Philadelphia 18, Pa.

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SEE YARWAY EXHIBITS
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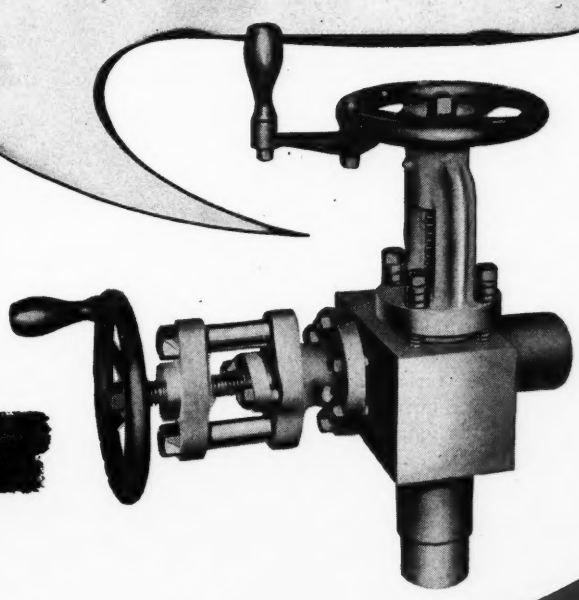
Steam Traps and Strainers — BOOTH 15-B, Main Floor

YARWAY

Yarway Unit Tandem Blow-Off Valves

For pressures to 2500 psi. Used for blowing or for draining and sealing. Combines the famous Yarway balanced sliding plunger Seatless Valve and a specially-designed Hard-Seat Valve in a single one-piece forged steel body. See Bulletin B-432. For other Yarway Blow-Off Valves suitable to lower pressures, see Bulletin B-424.



GOOD BOILER PROTECTION

STEAM PLANT EQUIPMENT

TURBINE TROUBLE

A large paper mill was having trouble from time to time with accumulation of paper pulp on the turbine blades.

The Hall engineer found no evidence to show that pulp could get to the boilers, and even if that had been possible, it was not conceivable that paper pulp could carry over with the steam in any amount.

Boiler water contamination was, therefore, eliminated as a possible source of the trouble —*but Hall engineers don't stop merely because they have shown that the boiler water conditioning has been satisfactory.* The engineer continued his check-up until he discovered that the drain pipe from the turbine seal ended in a drain ditch. Usually the ditch was practically dry but during the periods when the paper machines were being washed, paper pulp was being discharged into this ditch. At such times the level of the water in the ditch was above the open end of the drain pipe.

The Hall engineer pointed out that if the turbine was shut down at a time when the ditch happened to be full, the vacuum created by the condensing steam would suck pulp out of the ditch into the turbine through the turbine seal. The drain line was broken at a union and the inner surface of the pipe was found to be coated with paper pulp—clear evidence that it was getting to the turbine in this way.

The cure was simple—a quarter-inch hole drilled in the drain-pipe above high-water mark in the ditch, to prevent the formation of a vacuum in the drain pipe. When this was done, there was no further trouble.

"Trouble shooting" of this kind is typical of the work of Hall engineers. Their primary task is to prevent trouble, but when trouble does occur they are prepared to trace it to its source and show how it can be eliminated. Our records show that time and again troubles encountered in plants that have Hall service are due to factors other than water.

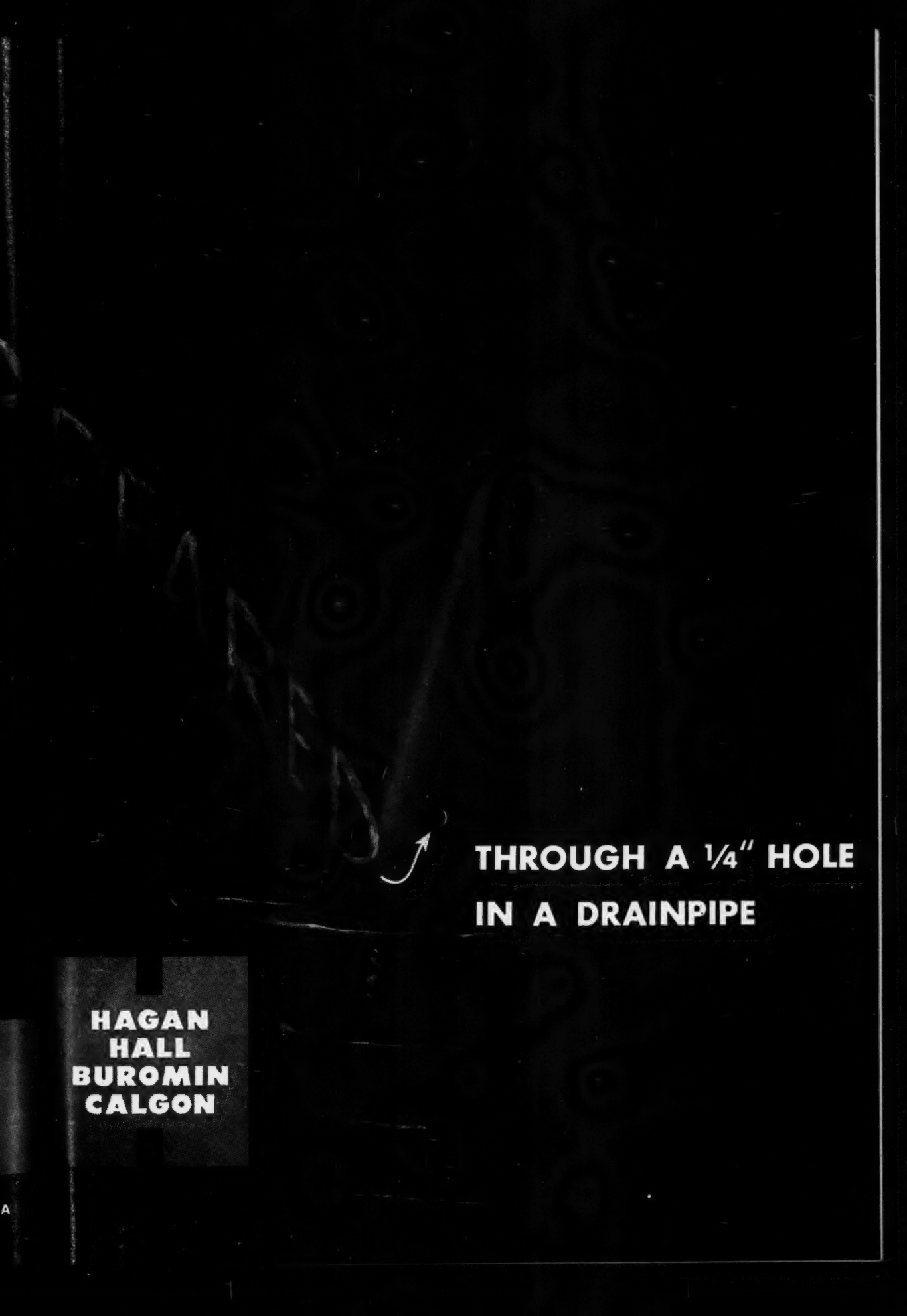
Every plant that generates its own steam can profitably use Hall Service.

We will be glad to send you full information.

HALL SYSTEM *of Boiler Water Conditioning*

HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH 30, PENNSYLVANIA

A subsidiary of Hagan Corporation


THROUGH A 1/4" HOLE
IN A DRAINPIPE
HAGAN
HALL
BUROMIN
CALGON

Developing the

Foster Wheeler steam generators today show the results of continuous research and pioneer engineering in the field of steam generating equipment. The technical know-how created has provided a fund of knowledge from which each new development has logically grown, and to which each new development has contributed. Net result of this backlog of experience has been the constant improvement in the design of high-pressure, high-temperature steam generators. Some of the contributions made by Foster Wheeler to this progress are outlined below.

1. **SUPERHEATERS** – First of many advancements was the introduction of superheaters in 1904. Superheated steam brought new problems, chief of which was control of final temperature. Several methods for controlling final temperature were used, but none proved as successful as the combination radiant-convection type superheater introduced in 1919. Refinement of this combination superheater gave satisfactory control of superheat, but still left room for improvement. The latest improvement came in 1941 when a condenser tube bundle was installed in the superheater inlet header of a large unit. This made possible wide range, accurate control of final temperature, permitting design, construction and operation in 1946 of the first central station unit to supply steam at 1000°F. final temperature. Superheat control range of this unit extends from 130,000 to 300,000 lb. per hour.

2. **ECONOMIZERS** – Parallel with development of the combination superheater went development of the unit economizer. Unit economizers were established as standard components of the modern steam generator in 1919. They gave an overall gain in efficiency and corresponding saving in operating cost. In addition, extended surface construction of unit economizers resulted in an important saving of space and a reduction in external tube corrosion.

3. **WATERWALLS** – Replacement of brick furnace walls with extensive water-cooled radiant heat-absorbing surface – waterwalls – came in 1922. Although departing from established practice, the reasons for eliminating brickwork were proved sound by reduced maintenance costs, prolonged furnace life, and higher firing rates in a cooler furnace. Slagging problems were also reduced.

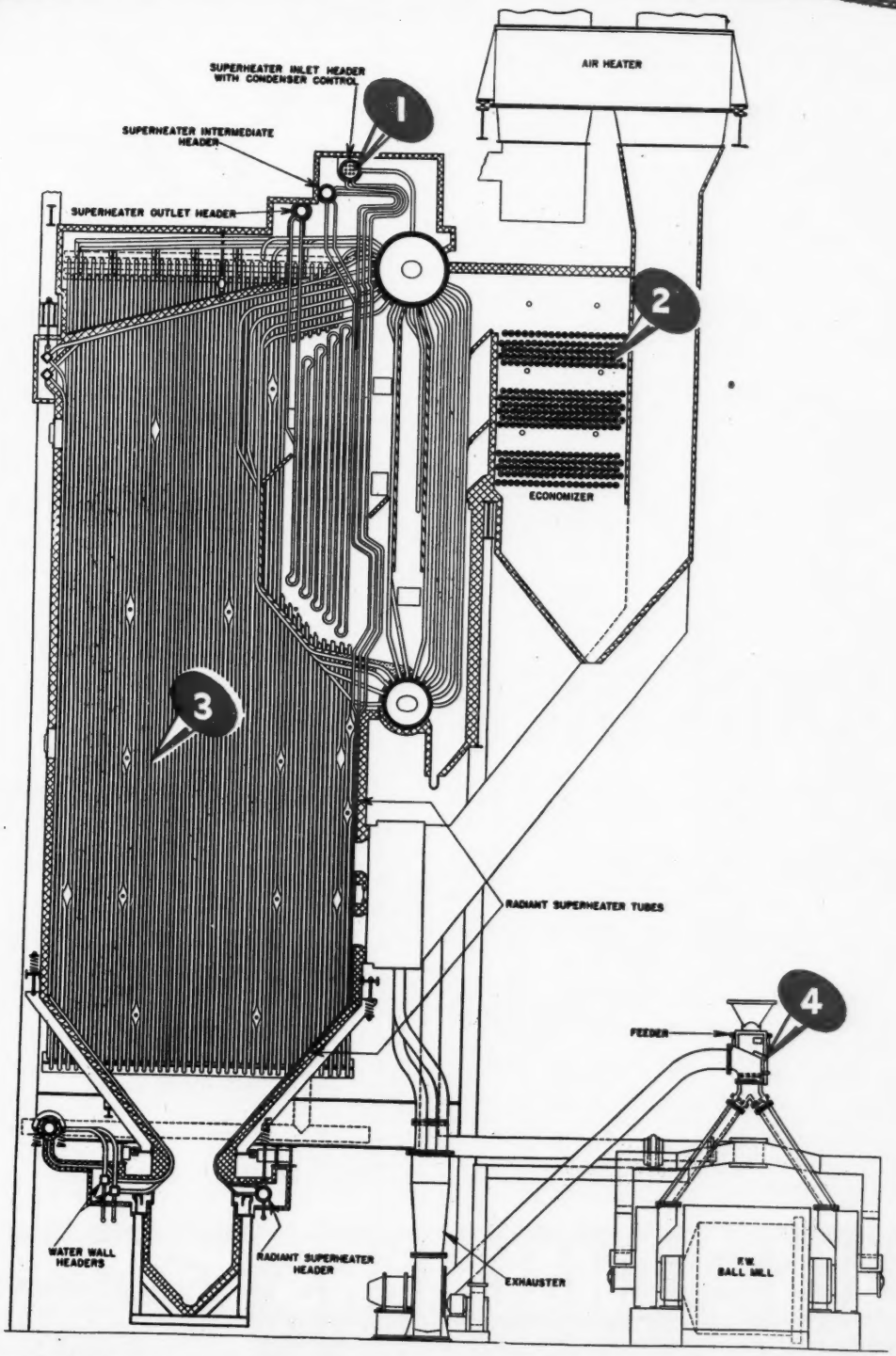
4. **PULVERIZERS** – The first pulverized fuel system to gain commercial acceptance was introduced in 1898. Since then, progressive improvements on the basic design have made possible the use of low-grade anthracite, formerly thought uneconomical as fuel. Also, FW ball mills consistently show high availability with low maintenance, another contribution to increased overall plant efficiency.

Progress is continuous. Foster Wheeler engineers are ready to work with power plant engineers to embody their specifications in designs for the exact steam power equipment their individual requirements dictate.

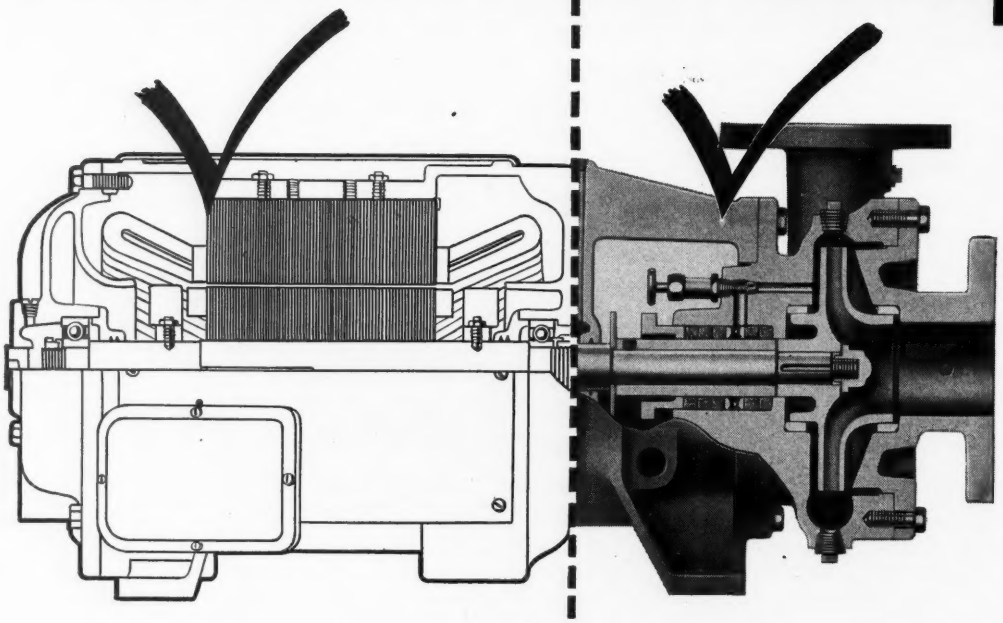
FOSTER WHEELER CORPORATION • 165 Broadway, New York 6, N. Y.

FOSTER WHEELER

MODERN STEAM GENERATOR



Motor *and* Pump



...combined

TO GIVE UNDIVIDED RESPONSIBILITY FOR CAPACITY... EFFICIENCY... HEAD

NOT ONE maker's pump hooked up to another maker's motor —but pump AND motor, designed and built as a unit by Allis-Chalmers.

There's no buck-passing. Allis-Chalmers backs every "Electrifugal" pump all the way — tests and checks the performance of each unit, at the factory.

FOR EVERY PUMPING NEED . . . CALL ON A-C

This versatile, popular "Electrifugal" pump is only part of the complete Allis-Chalmers line of centrifugal, axial and mixed-flow pumps — single or double suction, single or multi-stage, capacities up to 170,000 gpm. Call your A-C office or dealer — or write for bulletin B6018. ALLIS-CHALMERS, MILWAUKEE.

A2073

SPLASH-PROOF, LO-MAINTENANCE MOTOR — specially built for pump service. Sturdy, long-life rotor, interchangeable stator coils.

PUMP AND MOTOR IN ONE RUGGED FRAME, and on the same shaft. Result: perfect alignment; smooth, vibrationless operation; longer bearing life.

EASY INSTALLATION AND MAINTENANCE. Just hook up and pump . . . operates in almost any position . . . all parts easily accessible for checking and service.

SIZES FROM ¾ TO 25 HP meeting a wide range of requirements as to capacity, head, and fluids to be pumped.

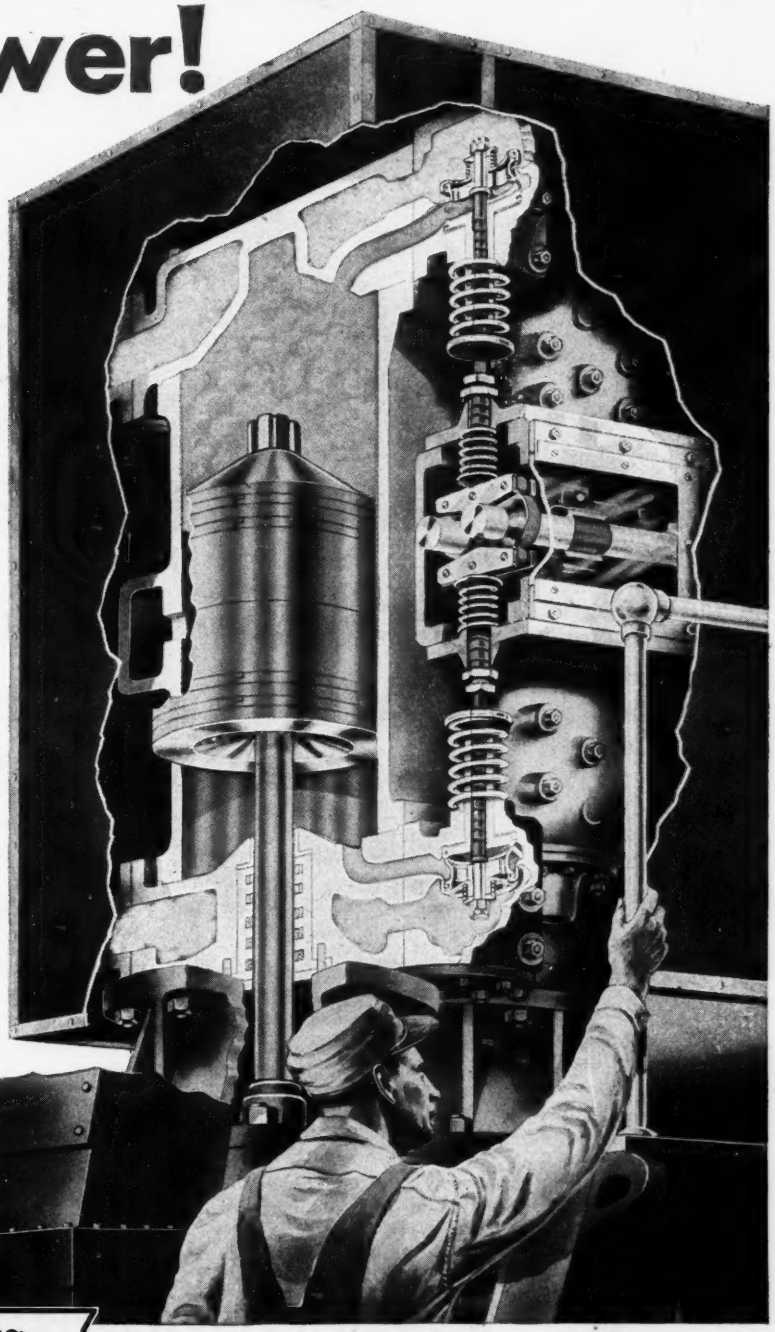
ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment
Biggest of All in Range of Industrial Products

Electrifugal PUMPS

What your steam engine needs to

Keep pouring out power!



CHANCES are it has been working longer hours, carrying heavier loads, during the past few years. So now, more than ever, it needs the best lubrication protection you can buy, to assure continuous operation, low power loss, low maintenance costs.

Gargoyle Super Cylinder Oils offer you this protection. Proved through the years in the toughest steam engine service, these famous oils resist high temperatures and the washing effect of moisture. They form strong films that persist on rubbing surfaces, and they separate readily from condensate to provide clean boiler feed.

Wear is reduced to a minimum on cylinder walls, pistons and rings. Valves and piston rod packings stay clean and free from hard abrasive deposits that cause steam blow-by and scoring of rods and stems. Your whole engine operates more efficiently. Get performance facts now from your Socony-Vacuum Representative.

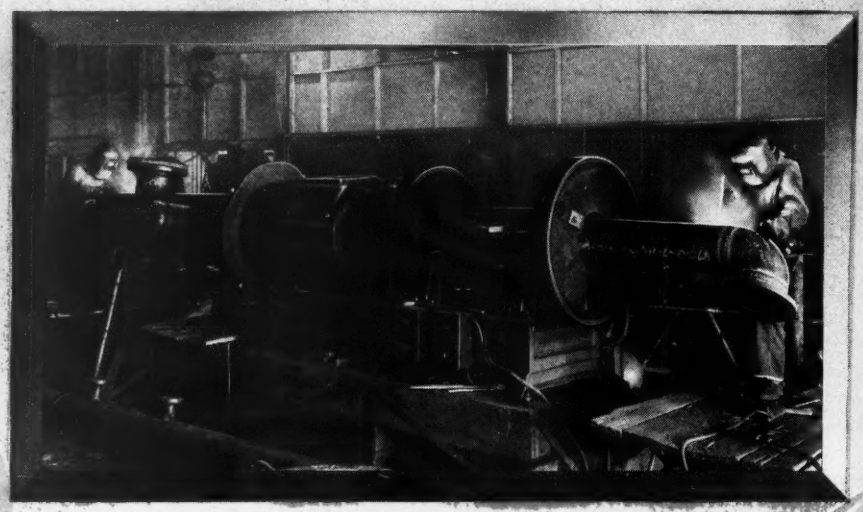
Get this Complete Lubrication Program for all your machines

- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
- Skilled Engineering Counsel
- Progress Reports of Benefits Obtained

GARGOYLE Lubricants

Socony-Vacuum Oil Company, Inc.

and Affiliates: Magnolia Petroleum Co., General Petroleum Corp. of Calif.



"As One User to Another"

MIDWEST Talks About PIPE WELDING FITTINGS

When you buy Midwest Welding Fittings, you get the same fittings that we use by the thousands in our own shop fabrication and field erection. So we can talk about pipe welding fittings "as one user to another."

We *know* that Midwest Welding Fittings save time in prefabricating piping . . . and in erecting piping in the field. Their sound design, dimensional accuracy and uniformity are features which are of definite help in making the job easier . . . in saving time and money . . . in providing better piping.

We *know* that the large variety of Midwest Fittings is another time and money saver . . . in addition to improving piping practice. We have reference to such Midwest developments as reducing elbows, "long tangent" elbows, shaped nipples, etc. See Bulletin WF-41 for complete information.

MIDWEST PIPING & SUPPLY Co., Inc.

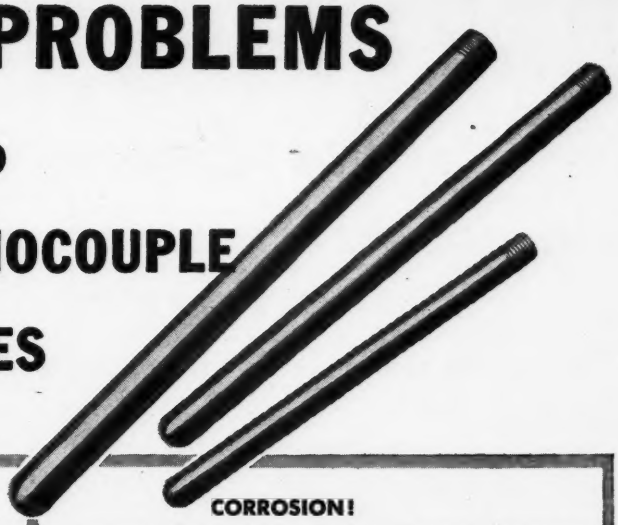
Main Offices: 1450 South Second Street, St. Louis 4, Mo.

Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities

2273

YOU SOLVE 4 PROBLEMS

when you switch to INCONEL* THERMOCOUPLE PROTECTION TUBES



HIGH TEMPERATURES!

Inconel is ***thermally durable.*** Hundreds of high-temperature applications in many fields have demonstrated the heat resistance of this 80% Nickel – 14% Chromium alloy. You can use Inconel thermocouple protection tubes up to 2200° F. in sulfur-free atmospheres.

And at ***any*** temperature, you'll find the thinner walls of close-grained Inconel tubes a big help where you need ***quick, accurate response*** to temperature changes.

CORROSION!

Inconel is ***corrosion-resisting.*** Because Inconel combines excellent thermal endurance with all-'round corrosion resistance, you can use Inconel protection tubes to guard thermocouples against chemical attack by carburizing vapors and gases . . . nitriding atmospheres . . . hydrogen-nitrogen atmospheres . . . fused salt baths.

The greater impermeability of ***seamless, drawn*** Inconel tubes also means better protection of thermocouples from harmful gases.

MECHANICAL SHOCK!

Inconel is ***strong*** and ***tough.*** And, it has good strength and toughness at high temperatures. In many jobs *(for example, forging furnaces)*, thermocouple protection tubes have to take bumps and jolts during charging and discharging. These are the jobs where use of Inconel pays an ***extra*** dividend. As a matter of fact, its high hot-strength frequently makes Inconel the choice even where excessive corrosion or high temperature is not a problem.

REDUCING AND OXIDIZING ATMOSPHERES!

Inconel has met the problem created by increased use of ***reducing*** atmospheres in bright annealing, nitriding, oxide reduction, and similar operations. Inconel gives long service in these processes because it resists the embrittling effects of hydrogen-nitrogen atmospheres.

Or if your operation is carried out in an ***oxidizing*** atmosphere, you can count on Inconel tubes here, too. For Inconel resists scaling . . . ***even at high heat.***

Prevent operating interruptions caused by thermocouple protection tubes that can't "take it."

Standardize on Inconel tubes wherever possible! For most jobs their longer life makes the cost ***actually less*** than the tubes you are now using.

Seamless, drawn Inconel protection tubes, with one end closed and the other end threaded, are available in standard IPS diameters. ***Your regular supplier or instrument manufacturer can furnish any size or length with either standard or extra-heavy wall thickness.***

*Reg. U. S. Pat. Off.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N. Y.

INCONEL ***– for long life at high temperatures***

(80 NICKEL - 14 CHROMIUM)

REPUBLIC CONTROLS

Are Being Specified

FOR ALL SIZES OF BOILERS AND ALL TYPES OF FUEL FIRING

TYPICAL INSTALLATIONS

SPREADER STOKERS

ALLIS-CHALMERS MFG. CO.
Springfield, Ill.
2 boilers: 68,000 lb./hr. each: 160 lb.

ALLIED CHEMICAL & DYE CO.
Chicago, Illinois
1 boiler: 45,000 lb./hr.: 125 lb.

BUICK AVIATION PLANT
Melrose Park, Illinois
1 boiler: 90,000 lb./hr.: 175 lb.

CHICAGO & NORTHWESTERN R. R. CO.
Green Bay, Wisconsin
2 boilers: 25,000 lb./hr. each: 125 lb.

HUBINGER CO.
Keokuk, Iowa
1 boiler: 150,000 lb./hr.: 500 hp.

CLINTON ENGINEERING WORKS
Clinton, Tenn.
3 boilers: 50,000 lb./hr.: 175 lb.

NORTHWESTERN YEAST CO.
Chicago, Illinois
1 boiler: 338 hp.: 140 lb.
2 boilers: 253 hp.: 140 lb.

MARSHALL CANNING CO.
Marshalltown, Iowa
1 boiler: 40,000 lb./hr.: 160 lb.

KRAFT FOODS
Albany, Minn.
2 boilers: 338 hp. each: 160 lb.

CHAIN GRATE STOKERS

ADAMS & WESTLAKE CO.
Elcart, Indiana
2 boilers: 500 hp. each: 125 lb.

BETHLEHEM STEEL CO.
Bethlehem, Pa.
4 boilers: 600 hp. each: 160 lb.

THE BERYLLIUM CORP. OF PA.
Temple, Pa.
2 boilers: 22,500 lb./hr. each: 145 lb.

CHICAGO, NORTHWESTERN R. R.
Chicago, Illinois
3 boilers: 45,000 lb./hr. each: 160 lb.

CLINTON PRODUCTS CO.
Clinton, Iowa
2 boilers: 25,000 lb./hr. each: 200 lb.

GAS FIRED

BEECH AIRCRAFT CORPORATION
Wichita, Kansas
2 boilers: 180 hp. each: 100 lb.

GULF POWER COMPANY
Pensacola, Florida
1 boiler: 230,000 lb./hr.: 875 lb.

GENERAL TIRE & RUBBER CO.
Waco, Texas
3 boilers: 16,000 lb./hr. each: 190 lb.

MATHIESON ALKALI WORKS, INC.
Lake Charles, La.
1 boiler: 420,000 lb./hr.: 925 lb.

MISSISSIPPI POWER CO.
Hattiesburg, Mississippi
1 boiler: 230,000 lb./hr.: 875 lb.

TIDEWATER ASSOCIATED OIL CO.
Avon, California
2 boilers: 100,000 lb./hr. each: 250 lb.

ABERCRAMBIE-HARRISON OIL CO.
Sweeney, Texas
4 boilers: 100,000 lb./hr. each: 250 lb.

PULVERIZED COAL

BELTON MILLS
Belton, South Carolina
1 boiler: 60,000 lb./hr.: 250 lb.

BOECKELER ASSOCIATES
Trenton, Michigan
1 boiler: 528 hp.: 125 lb.

GEORGIA POWER COMPANY
Harryat, Georgia
1 boiler: 600,000 lb./hr.: 975 lb.

HARTFORD CITY PAPER COMPANY
Hartford City, Indiana
1 boiler: 80,000 lb./hr.: 325 lb.

CLINTON ENGINEERING WORKS
Oliver Spriggs, Tenn.
1 boiler: 750,000 lb./hr.: 1375 lb.

N. Y., N. H. & HARTFORD R. R. CO.
Cos Cob, Conn.
1 boiler: 150,000 lb./hr.: 325 lb.

PRATT & WHITNEY
East Hartford, Conn.
2 boilers: 20,000 lb./hr. each: 175 lb.

OIL FIRED

BAY REFINING CORP.
Bay City, Michigan
1 boiler: 350 hp.: 245 lb.

FITCHBURG GAS & ELEC. LIGHT CO.
Fitchburg, Mass.
2 boilers: 120,000 lb./hr. each: 200 lb.

PHILADELPHIA NAVY YARD
Philadelphia, Pa.
2 boilers: 130,000 lb./hr. each: 175 lb.

CITIES SERVICE REFINING CORP.
Lake Charles, La.
4 boilers: 140,000 lb./hr. each: 250 lb.
2 boilers: 200,000 lb./hr. each: 250 lb.

KADOTA FIG ASSOCIATION
Merced, California
1 boiler: 505 hp.: 155 lb.

HIGGINS AIRCRAFT, INC.
New Orleans, La.
2 boilers: 75,000 lb./hr. each: 180 lb.
2 boilers: 40,000 lb./hr. each: 180 lb.

UNDERFEED STOKERS

EDWARD G. BUDD MFG. CO.
Philadelphia, Pa.
3 boilers: 100,000 lb./hr. each: 150 lb.

CHEVROLET MOTORS
Bay City, Michigan
1 boiler: 600 hp.: 150 lb.

INDEPENDENT PNEUMATIC TOOL CO.
Aurora, Illinois
1 boiler: 300 hp.: 300 lb.

THE OLD QUAKER CO.
Lawrenceburg, Indiana
2 boilers: 500 hp. each: 160 lb.

REO MOTORS, INC.
Lansing, Michigan
1 boiler 40,000 lb./hr.: 260 lb.

U. S. FINISHING CO.
Norwich, Conn.
1 boiler: 40,000 lb./hr.: 165 lb.

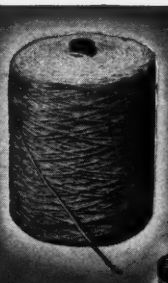
UPJOHN COMPANY
Kalamazoo, Michigan
1 boiler: 40,000 lb./hr.: 160 lb.

COLUMBUS ASF DEPOT
Columbus, Ohio
1 boiler: 26,000 lb./hr.: 90 lb.

WRITE FOR DATA BOOK NO. S-21

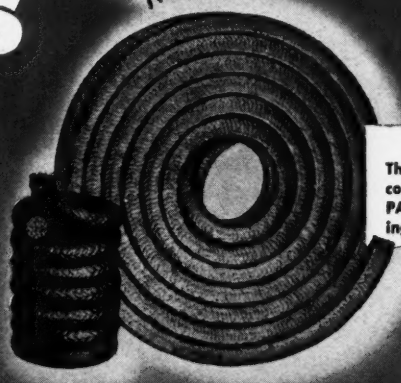
REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

Why PALMETTO Self-Lubricating PACKINGS last longer ...cost less



1 Individual strand of yarn —best obtainable Canadian white asbestos—before impregnation.

2 The saturated yarn—after impregnation with special PALMETTO lubricant.



3 The finished product—the completely *Self-Lubricating* PALMETTO Braided Packing.

Here you see three stages in the exclusive process which makes PALMETTO Packings "*Self-Lubricating*". In this process *each separate strand* of asbestos or cotton is saturated with a special PALMETTO lubricant—forced into the yarn under heat and pressure! At the same time, each strand is *individually graphited* . . . the graphite flakes act as dams to trap and hold a reservoir of lubricant in the yarn. After this, the impregnated strands are braided, plaited or twisted—round or square—to the size required to form the finished *self-lubricating* packing. The result? A completely and permanently lubricated PALMETTO Packing with these five advantages:

1. *Long packing life*—because self-lubricating properties permit the packing to retain original efficiency for long periods.

2. *Low friction*—because the packing remains soft and resilient in service.

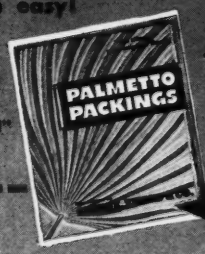
3. *Reduced wear on machinery parts*—because there is a film of lubricant between the packing and moving rods or shafts at all times.

4. *Easier removal and installation*—because packing stays easy-to-handle and does not disintegrate in service.

5. *Lower maintenance costs*—because packing functions without frequent adjustment or constant attention.

These five specific advantages will enable you to increase efficiency and cut packing costs. For a quick, informative look at the simple—yet complete—PALMETTO line of packings, send today for your copy of the new PALMETTO Condensed Catalog (PC-100). It makes packing selection easy!

"IT PAYS TO KNOW YOUR PALMETTO DISTRIBUTOR!"



MAIL COUPON TODAY FOR NEW PALMETTO CATALOG!

GT-1374

GREENE, TWEED & CO.

GREENE, TWEED & CO.
New York 66, N. Y.

Send my copy of the new PALMETTO Condensed Catalog.

NAME .....

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Company .....

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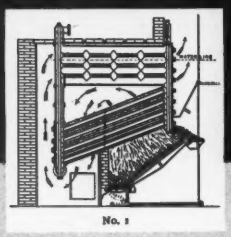
City ..... State .....

Setting Boiler



No. 1

The original Babcock & Wilcox boiler, sold in 1867, was of only 50 hp. capacity. Contrast the relative size of this first successful water-tube boiler with the modern unit illustrated below.

Two B&W Open-Pass boilers of this design went into service in an eastern central station in 1946. Each is capable of delivering 1,000,000 lb. of steam per hour.

Standards for 80 Years

When the first B&W boiler—a 50 hp. unit—went into service in 1867, a new era in safe, efficient steam generation began. Since then, B&W has never outgrown its original habit of advanced thinking . . . of having new ideas . . . of pioneering developments that steadily raised the standards in boiler making and operation. The welding of boiler drums and X-ray inspection of welds: the development of high-pressure boilers, research in high-pressure, high-temperature steels; and perfection of better methods for producing clean, dry steam are notable examples of B&W's contribution to progressive steam generation. These and other refinements are widely found in B&W boilers including the Integral-Furnace, the Radiant, and the Open-Pass boilers, which were introduced by B&W. This background of leadership is one of the reasons so many power men have been coming to B&W first for so many years . . . for lasting satisfaction.

G-364 T

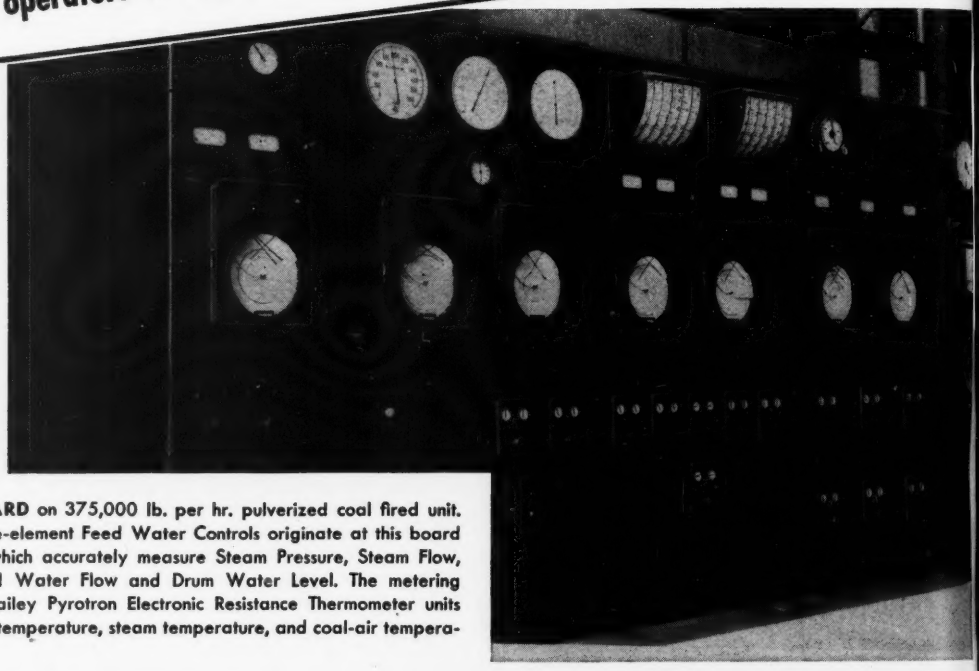
Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

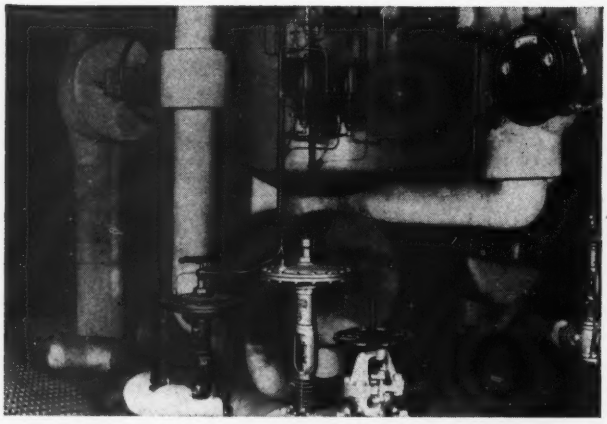
THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

Dedicated to Optimum Steam Plant Performance

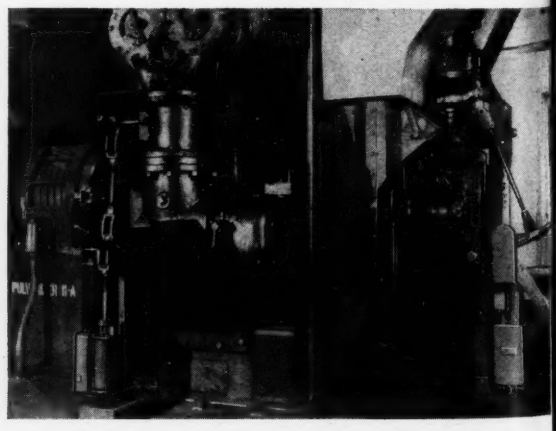
Bailey Controls at Williamsburg Station of Pennsylvania Edison Co. help operators to secure Safety, Economy and Continuity of Service



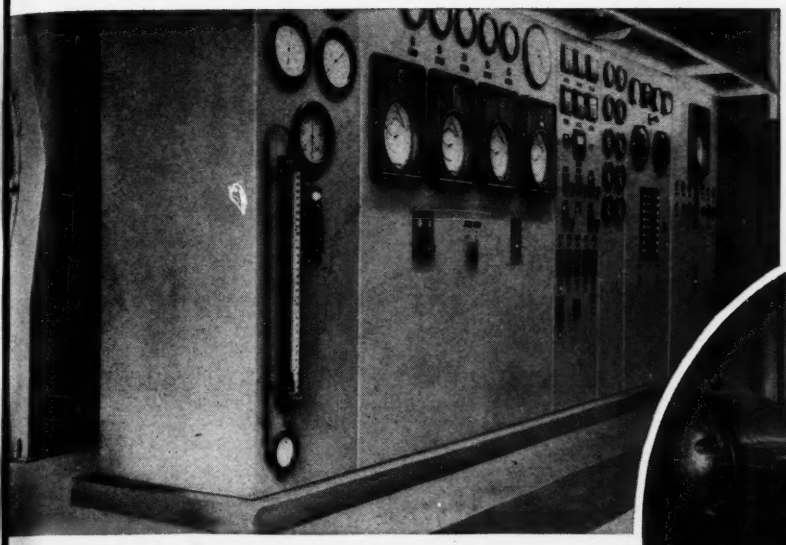
BAILEY BOILER BOARD on 375,000 lb. per hr. pulverized coal fired unit. Combustion and Three-element Feed Water Controls originate at this board from Bailey Meters which accurately measure Steam Pressure, Steam Flow, Air Flow, Draft, Feed Water Flow and Drum Water Level. The metering equipment includes Bailey Pyrotron Electronic Resistance Thermometer units to record feed water temperature, steam temperature, and coal-air temperature at each mill.



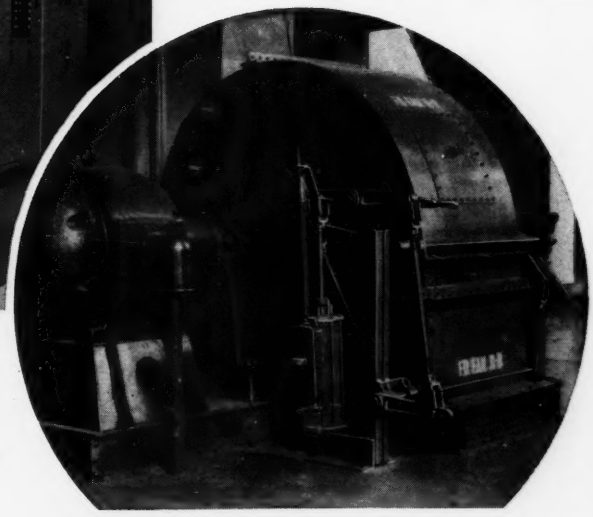
HEATER DRAIN CONTROL. Bailey Level Controller and relays regulate drain valves to maintain the desired high pressure drainer level.



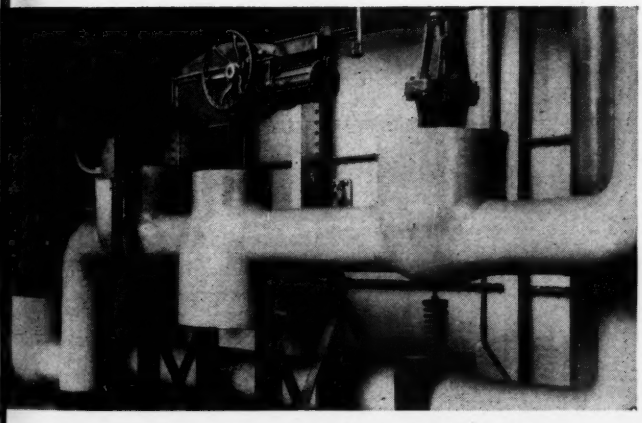
PULVERIZER CONTROL. These Bailey Control Drives regulate raw coal feed and coal-air output from a Riley Atrita Pulverizer in accordance with boiler load demand as measured by the Bailey Master Steam Pressure Controller.



TURBINE BOARD. A Bailey Three-element System of condensate control originates at this board from the first three recording meters which measure: (1) Total flow output from high pressure boiler feed pumps, (2) Condensate flow to No. 1 Heater, (3) Level in No. 3 Heater. The fourth meter records and integrates steam flow to the high pressure turbine and a fifth meter records pressure and temperature of desuperheated steam.

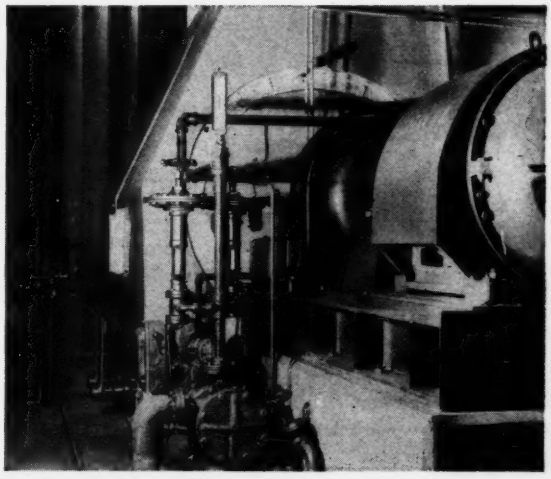


FORCED DRAFT FAN CONTROL. Bailey Control Drives position inlet vanes to supply air for combustion in accordance with the requirements established by the Master Steam Pressure Controller and the Bailey Boiler Meter.



BAILEY THREE-ELEMENT FEED WATER CONTROL VALVE. This powerful valve regulates feed water input to the boiler so that it equals steam output and maintains a safe drum level at all times. Control impulses originate from the accurate measurements of Bailey Meters on the Boiler Board.

All photos by the courtesy of Burns & Roe, Inc. For more information on coordinated Boiler Control Systems, such as installed at the Williamsburg Station, ask for Bulletin 15-C.



INDUCED DRAFT FAN CONTROL. Bailey Control Drive and Valves regulate the induced draft damper and the hydraulic coupling fan speed control to maintain the desired furnace draft.

A-96

BAILEY METER COMPANY

1040 IVANHOE ROAD • • • CLEVELAND 10, OHIO

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Controls for Steam Plants

It's time to MODERNIZE

No old stoker can match the efficiency and dependability of the modern Iron Fireman

OBSOLETE STOKERS HAVE THESE EARMARKS

HIGH FUEL COSTS

Many old stokers are trying to carry increased loads by using premium coals. Others lack the precision control of fuel and air for most efficient combustion. Coke in ash is a visible evidence of fuel waste, of which many out-moded stokers are guilty. Iron Fireman engineers will analyze your fuel costs without charge.

EXCESSIVE STACK LOSSES

Although smoke is one evidence of stack loss, some of the most serious wastes occur in smokeless stacks. Out-moded stokers cannot control the combustion processes with sufficient precision to prevent high stack losses. Iron Fireman tests will reveal how much you are paying for such losses.

LOW BOILER OUTPUT

Most old stokers are unable to produce the steam output of which the boiler itself is capable. There may be several contributing causes besides the inadequacy of the stoker, such as poor draft conditions, improper installation, etc. Iron Fireman has successfully replaced hundreds of stokers where greater boiler capacity was required.

WASTED BOILER ROOM LABOR

Many old stokers waste man hours because they have high hoppers that are hard to fill. In some cases hoppers and mechanism overhang fire doors, making fire cleaning difficult. Also mechanism that is hard to reach or located in areas of intense heat add to labor costs. Iron Fireman Coal-Flow models feed from main bunker, have no boiler front obstructions, no inaccessible machinery.

HIGH FURNACE AND STOKER MAINTENANCE Watch your repair bills—they may be a warning. An undependable stoker, quite beyond its maintenance cost, may cause losses that amount almost to havoc when stoker breakdown or burned out furnace lining forces a plant shut-down. It is *never* profitable to let a stoker die of old age.

TIME LAG IN LOAD PICK-UP

Stokers that are not readily responsive to load demands are not only a drag on the whole plant—they are fuel wasters. Iron Fireman stokers, in both the underfeed and pneumatic spreader types, preheat the coal and add both fuel and air without disrupting the fuel bed, and are therefore highly sensitive to load changes.

WITH all fuels rising in cost, Iron Fireman stokers enjoy an outstanding advantage in their ability to burn a wide range of coals, permitting the efficient use of whatever type is most economically supplied by the local market.

Iron Fireman's efficient conveying system not only saves boiler room labor, but often saves large investments in coal handling equipment. Its adaptability to existing boiler room layouts avoids costly alterations.

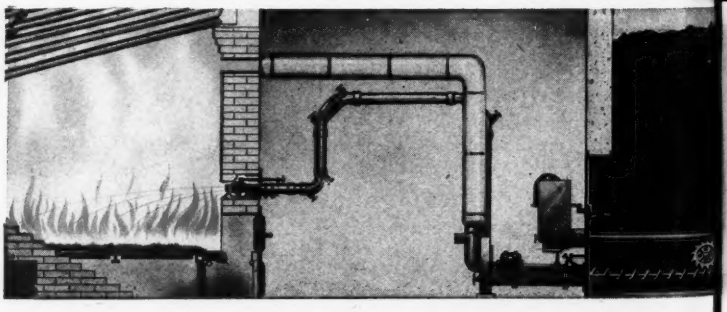
Iron Fireman's instant responsiveness to load variations, and its automatic, continuous control of the fuel-air ratio make the modern Iron Fireman a great fuel saver.

Iron Fireman's exceptional dependability, (which is another word for low maintenance cost) is due to sturdy construction, easy accessibility, and separation of all mechanical parts from destructive furnace heat.

Iron Fireman's nation-wide organization assures an engineered installation, carefully planned in each individual case to get maximum efficiency from your boiler. A routine result of an Iron Fireman installation is increased boiler capacity.

How the IRON FIREMAN Pneumatic Spreader stoker operates

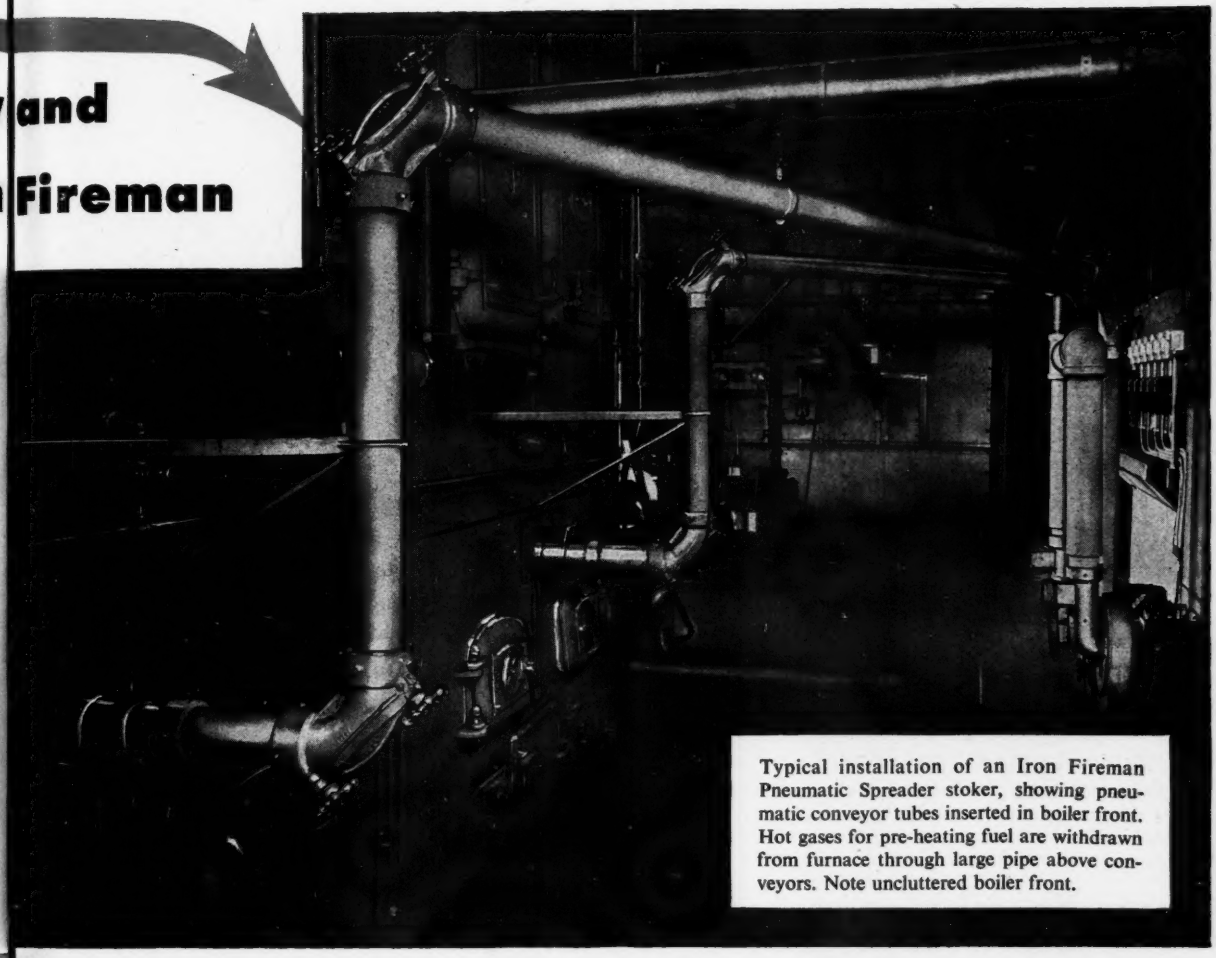
The Iron Fireman Pneumatic Spreader Stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which to not preheat fuel.



Heavy Duty Automatic Coal Stokers for Power, Processing and Heating

with an IRON FIREMAN stoker

ncy and on Fireman



Typical installation of an Iron Fireman Pneumatic Spreader stoker, showing pneumatic conveyor tubes inserted in boiler front. Hot gases for pre-heating fuel are withdrawn from furnace through large pipe above conveyors. Note uncluttered boiler front.

Do you KNOW what your steam costs are?

Here's how to find out . . . The first step toward reducing steam costs is to know exactly what your costs are now. Iron Fireman engineers are fully equipped to make a factual study of your boiler room operations. They can measure your stack losses, determine the efficiency of your boilers, make a scientific appraisal of stoker and furnace, and tell you how much of the fuel you buy is wasted and how much you are able to apply as usable heat. Their study will also show what an engineered Iron Fireman installation will accomplish in your present boiler.

This service is performed without expense or obligation on your part. Iron Fireman's engineering, sales and service organization covers the continent. Write for engineering survey or for literature to Iron Fireman Mfg. Co., 3053 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Stokers for every size and type of firing job.

IRON FIREMAN

Diet Control
for a million-dollar appetite

Give your slide rule a bit of exercise the next time you consider a boiler installation by figuring out just how many dollars' worth of fuel that boiler will consume during its useful life. You will find that even a moderate sized boiler has a million-dollar appetite.

You will equip that boiler with Automatic Combustion Control, of course, but you may be undecided about which control to install. The first cost of Hagan Control is usually a bit higher, and you may find yourself thinking that you can save a few dollars by using something cheaper.

If so, just keep that slide rule working and figure out how small that saving is in comparison with the fuel cost—or, for that matter, how small the cost of the whole control system is.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

The thing that is really important is not the cost of the control system, but what that system will do to your fuel costs—and that brings you right back to Hagan.

Hagan Automatic Combustion Control is designed for the sole purpose of *control.* It is separate from the metering. Because of its design and construction, Hagan control is sensitive to extremely small changes in steam load; it follows these changes accurately and instantly. The steam flow-air flow chart of any Hagan-equipped boiler is evidence of the inherent stability of the Hagan system.

Hagan equipment lasts as long as the boiler—and gives you dependable, trouble-free service as long as it lasts. Our engineers are at your service.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Anticipation of Future Tubing Requirements Pays Big Dividends

All indications point to busy years ahead for power plant operators, who must continue to meet increasing demands for electricity. The use of electric power in the home for cooking, heating, refrigeration, radio, laundry and other necessities and luxuries of life continues to increase as new applications develop. In industry the use of electricity continues to grow for the melting and heat treating of metals, drying finishes, motorized machines, the handling of materials and many other devices too numerous to mention.

Another important factor is rural electrification. According to Fortune magazine, during the past eleven years the percentage of farmers having electricity has risen from 11% to around 50%, and another 1,500,000 farm families are expected to receive the benefits of electricity within the next three to five years. It has also been stated that most farmers who do have electricity are not making anywhere near full use of all its possibilities at the present time. These facts indicate that consumption of electric power by rural communities is definitely on the increase.

With all this progress come new responsibilities for power plant engineers, who not only must operate under heavy schedules, but also at maximum efficiency and with greatest economy in order to compensate for rising costs. Since the satisfactory functioning of condenser tubing affects the entire operation of the power plant the most advantageous purchase of this important item deserves serious consideration.

Order Condenser Tubing Early

In the case of new construction it has been the custom of engineers to place their orders for such equipment as rotors, pumps, turbines and condenser shells far in advance of orders for condenser tubing. This is usually left until the last, with the result that unforeseen delays may hold up completion of the entire project. A change in procedure would be most beneficial and the advantages of ordering condenser tubing at the same time as other equipment are very evident.

From the maintenance angle operators can benefit by anticipating their retubing requirements so they can be sure of having tubing on hand when it is needed and protect themselves against shut-downs due to premature tubing failure. Under such conditions retubing operations can be scheduled more efficiently.

Plan For More Severe Water Conditions

Another way in which power plant operators can anticipate future requirements is to plan for more severe water conditions. Generally speaking, harbors, estuaries, rivers and inlets on which most power plants are located are becoming more and more polluted by sewage, chemicals, and industrial wastes. This is a natural result of industrial expansion and growth in population centers; therefore, conditions are more likely to become worse than better. In some cases water conditions may already have undergone considerable change with the result that a condenser tube alloy, which may have given satisfactory service in the past, fails prematurely.

Operating conditions are also becoming more severe. The number of condenser service hours per year is on the increase, with some approaching continuous operation. More water rushing through the condenser at greater speeds to condense steam faster, increases the efficiency of the surface condenser, but imposes more severe operating conditions on the condenser tubing.

Service Tests Help Determine Most Suitable Tubing

Since conditions vary widely among power plants located in different parts of the country it is often desirable to try out test lots of sample tubing under actual operating conditions. Information gathered in this way is correlated with data made available through Bridgeport's corrosion research laboratory, so that a condenser tube alloy can be recommended which will stand up most satisfactorily under the conditions present in that particular power plant.

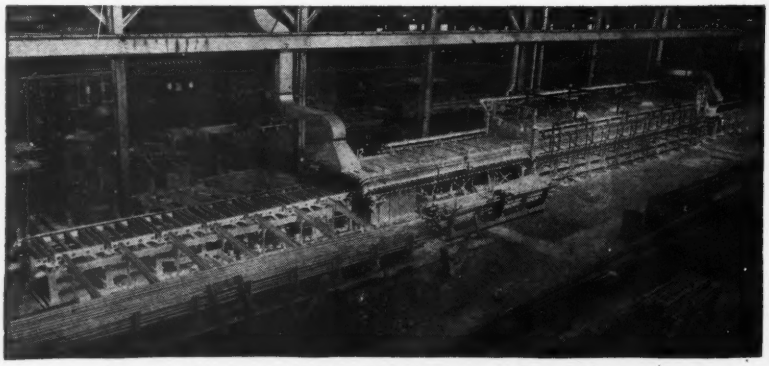
Another important source of information regarding condenser tube life is the study of samples sent in by power plant operators. The type of corrosion can be determined and the physical condition of the tubes is studied to indicate their probable life.

Other factors such as alloy composition and information regarding operating data and water conditions are taken into consideration. Power plant engineers should contact the laboratory before samples are removed, since it is important that such samples conform to certain requirements in order to obtain the greatest possible benefit from their laboratory examination.

Corrosion-Resistant Alloys Available

Bridgeport produces a wide range of condenser tube alloys, such as Duronze IV (aluminum bronze), Cupro Nickel, Arsenical Admiralty, Arsenical Muntz, Cuzinal (aluminum brass), and Red Brass. A consistent program of laboratory control is followed involving constant checking by chemical and spectrographic analyses, determination of physical properties and microscopic examination to make sure that the finished tubing successfully meets specifications and will stand up under the conditions for which it is intended.

For assistance in getting the most out of condensers through selection of the most suitable tubing alloy contact Bridgeport's laboratory through the nearest Bridgeport office. In the meantime write for Bridgeport's 112-page Condenser Tube Manual containing practical, up-to-date information about corrosion research, condenser tube alloys, methods of installing and suggestions for increasing condenser tube life.



New roller hearth, controlled atmosphere furnace used in the manufacture of condenser tubing at Bridgeport Brass Company.

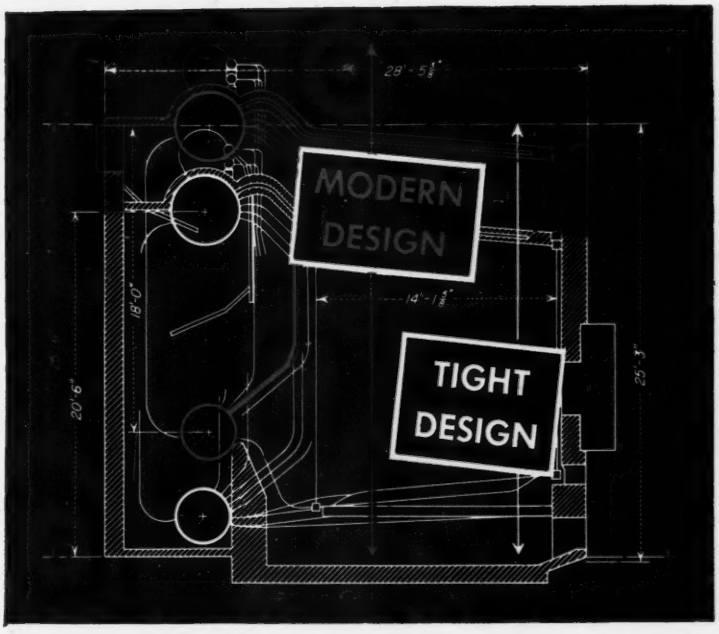
BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Defining "FLEXIBILITY"

TIGHT DESIGN–restricted fuels
MODERN DESIGN–fuel flexibility

DESIGN SPECIFICATION The Design Specification should give the critical characteristics of typical fuels which will be economically available during the life of a new Power Plant. A leading equipment manufacturer selects Ash Softening Temperature as a controlling factor, and says, *"The basis of modern boiler and furnace design is to proportion the furnace and cooling surface in the furnace that under average conditions of furnace wall cleanliness, the temperature of the gas entering the boiler surface will be below the ash fusion temperature."*



RANGE IN QUALITY The Fuel Investigation develops the range in fuel quality which should be planned for. This manufacturer shows here a "tight design" requiring the use of restricted fuels, and outside of this he shows a "modern design" with a larger furnace so proportioned that a wide range of fuels can be used.

FLEXIBILITY Sound planning requires that new or modernized power plants provide sufficient latitude to permit the utilization of the range of coals competitively available during their useful life. In so doing, Utilization Flexibility is achieved.

FAIRMONT COAL The Fuel Investigation reveals that Fairmont Coal will probably be an excellent value in many markets for many, many years. Utilities and Industrials are using Fairmont Quality as the design basis for new power plants.

Designing for Fairmont Coal permits the use of a wide range of fuels. Initial investment for flexibility is somewhat higher, but the additional cost can be quickly amortized and permanent savings are possible through the use of the best fuel value available.

MAIL COUPON TODAY

FAIRMONT COAL BUREAU · FAIRMONT REGION · WEST VIRGINIA · SERVICE TO INDUSTRY

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.

Write for Reference Bulletin No. 5 for the details on investment required for flexibility in plants requiring 400,000#, 200,000#, or 60,000# of steam per hour. Your request will automatically put your name on our mailing list. PPE-12-46

NAME .....

COMPANY .....

POSITION .....

STREET ADDRESS.....CITY.....ZONE.....STATE.....

ASBESTOS IN ACTION

why

you should know more about

K&M "Century" ASBESTOS CORRUGATED

This tall mining headhouse will withstand a lifetime of beatings from wind, weather and other tough conditions. It's completely sheathed with "Century" Asbestos Corrugated.

If you are planning repairs, remodeling, or new construction, the choice of building materials is all-important to you. Here are six compelling reasons why K&M "Century" Asbestos Corrugated has proved to be the ideal industrial siding and roofing material:

1. Corrosion-proof . . . "Century" Corrugated resists the effects of rust, corrosion, smoke, soot, moisture, oil, other conditions so destructive to ordinary building products.

2. Weather-proof . . . withstands the worst the elements can bring.

3. Fire-resistant . . . it *cannot* burn, and it helps prevent spread of fire.

4. Speedily installed . . . large easy-to-work unit sizes speed construction, hold labor costs to rock-bottom.

5. Extremely strong . . . corrugations build *extra* structural strength into rugged asbestos-cement composition. It actually grows tougher with age.

6. Maintenance-free . . . first cost is *last* cost. Never needs painting, will not warp, rot, or decay.

It will pay you to send for full descriptive matter on "Century" Asbestos Corrugated and Flat Lumber. Just write us, we'll put it in the mail at once.

K&M best in asbestos

Nature made Asbestos . . .
Keasbey & Mattison has been making it serve mankind since 1873

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

FOR TOUGH PUMPING JOBS

★ FOR THICK FLUIDS ★ FOR MINIMUM PULSATION

★ FOR VARYING HEAD ★ FOR MARINE SERVICE

SIER-BATH SCREW PUMPS

Handle Asphalt, Acetate, Brines, Bunker C Fuel Oil, Cellulosics, Greases, Molasses, Syrups.

● Sier-Bath Screw Pumps are built for the jobs that stump other pumps. They handle pastes, plastics and semi-liquids, with maximum efficiency, minimum pulsation. Less affected by head than other displacement pumps, they are practically unaffected by angle of inclination.

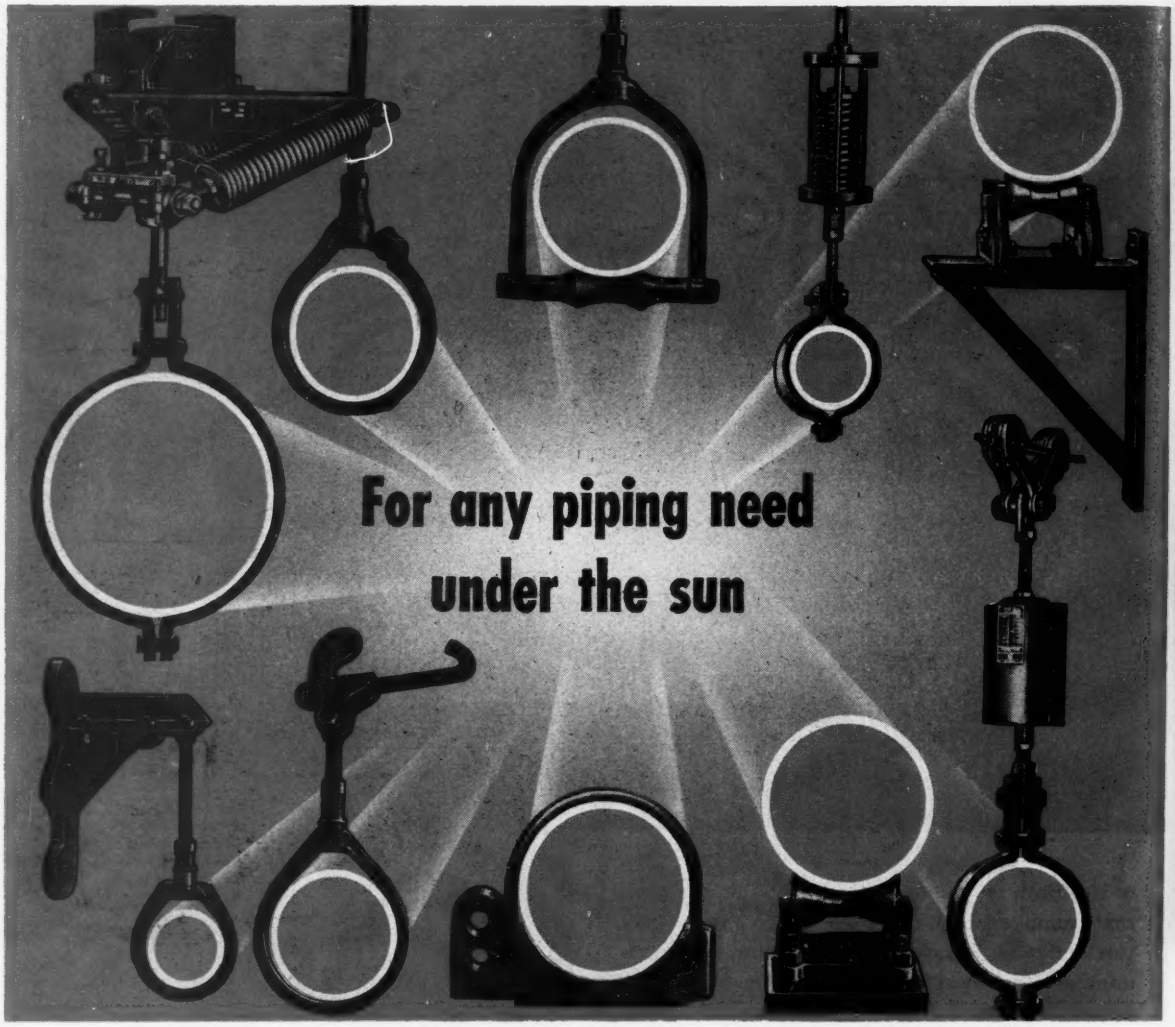
Simple, with only two moving parts, Sier-Bath Screw Pumps are low in maintenance. Their end-to-center fluid flow eliminates thrust bearings. Their self-centering timing gears eliminate side-wear resulting from screw contact. Packing can be added while pump is running. Their smooth discharge reduces tip cleaning and improves efficiency in oil burner service. Built to close tolerances, Sier-Bath Screw Pumps have ***roller bearings as standard design.***

Available in horizontal and vertical models. Removable liners may be specified if desired. Bulletin now available contains full data on pump selection, viscosity tables, definitions, etc. Write for it.

See our Booth No. 568
New York Power Show, December

Also manufacturers of
SIER-BATH GEAREX ROTARY PUMPS and SIER-BATH PRECISION GEARS

Sier-Bath GEAR and PUMP CO., Inc.



GRINNELL PIPE HANGERS AND SUPPORTS

There is a standard or special purpose Grinnell Hanger for any piping installation – from a simple water pipe to a high pressure, high temperature steam line.

Not only do correctly engineered hangers save you valuable installation time, but they also provide such definite advantages as • *Easy adjustment during and after pipe erection* • *Full provision for thermal movement where necessary* • *Easy maintenance* • *Compliance with all piping code requirements.*

Don't waste time and take chances with inadequate pipe hangers and supports – let Grinnell supply the exact hangers to meet your needs.

GRINNELL COMPANY, INC.
Executive Offices: Providence 1, R. I.

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Atlanta 2, Ga.	Los Angeles 13, Cal.	Providence 1, R. I.
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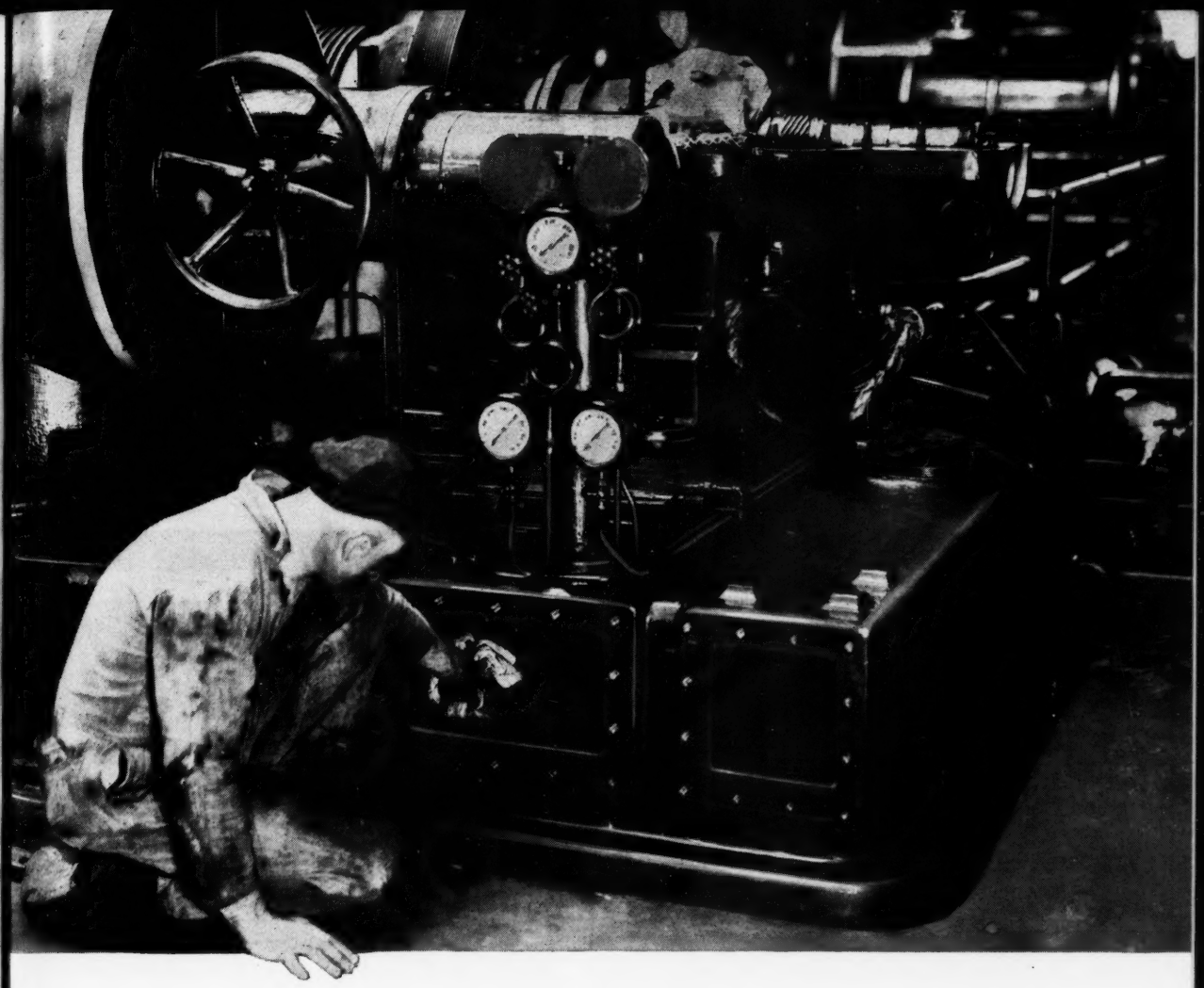
GRINNELL
FOUNDED 1850
WHENEVER **PIPING** IS INVOLVED



Who says cleaning a turbine oil system is easy?

"TAKE MY WORD, it's a time-taking, back-breaking job." And you can add, an *unnecessary* job.

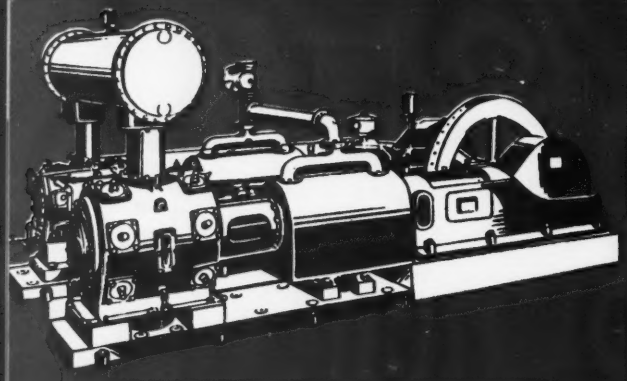
Maybe the cost for labor and maintenance isn't great. But that's not the most costly item you may have to pay where oil systems become fouled with oil deposits. Why take a chance on clogged oil passages and burned bearings —or risk the possibility of excessive acidity increase requiring oil changes or oil treating.

It's a needless risk. Nonpareil Turbine Oil does *not* foul turbine oil systems. It is *guaranteed* not to increase in acidity above 0.15 mg.KOH/gm. *for the life of the turbine.* Turbine operators with 18 years' experience using Nonpareil will tell you that this highly refined, oxidation inhibited oil has saved many barrels of oil, many hours of labor for cleaning turbines or treating oil, and all the worry over oil failure.

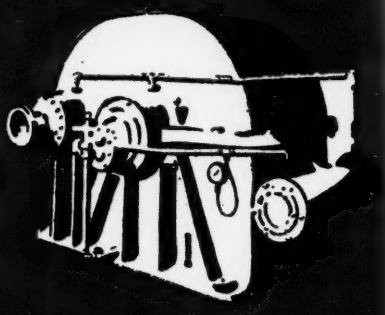
The Standard Oil Lubricating Engineers will be glad to explain the written guarantee that is given with every fill of Nonpareil. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TURBINE OIL

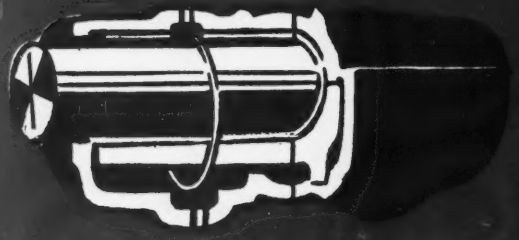
STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE



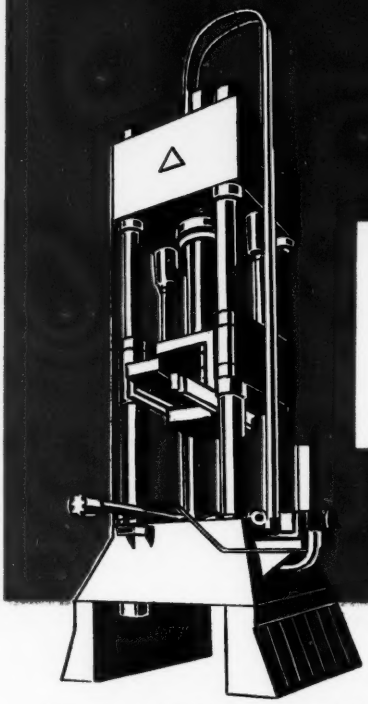
Less deposits in compressors because the improved oxidation stability of Stanoil resists heat . . . the low carbon forming base oil in Stanoil helps keep valves free from carbon.



Fewer oil changes in gear cases because the inhibitor in Stanoil prevents excessive acidity and deposit formation over long periods of operation.



Low bearing wear because of Stanoil's high lubricating quality and because its high viscosity index assures a free flow of the lubricant at starting, and resistance to thinning out as temperatures increase during operation.



Reliable hydraulic system operation because Stanoil contains an anti-foaming additive which prevents erratic operation caused by air entrained in the oil.

You get all these advantages in one oil . . . STANOIL

For further advantages of Stanoil in many applications in your plant see a Standard Oil Lubrication Engineer.

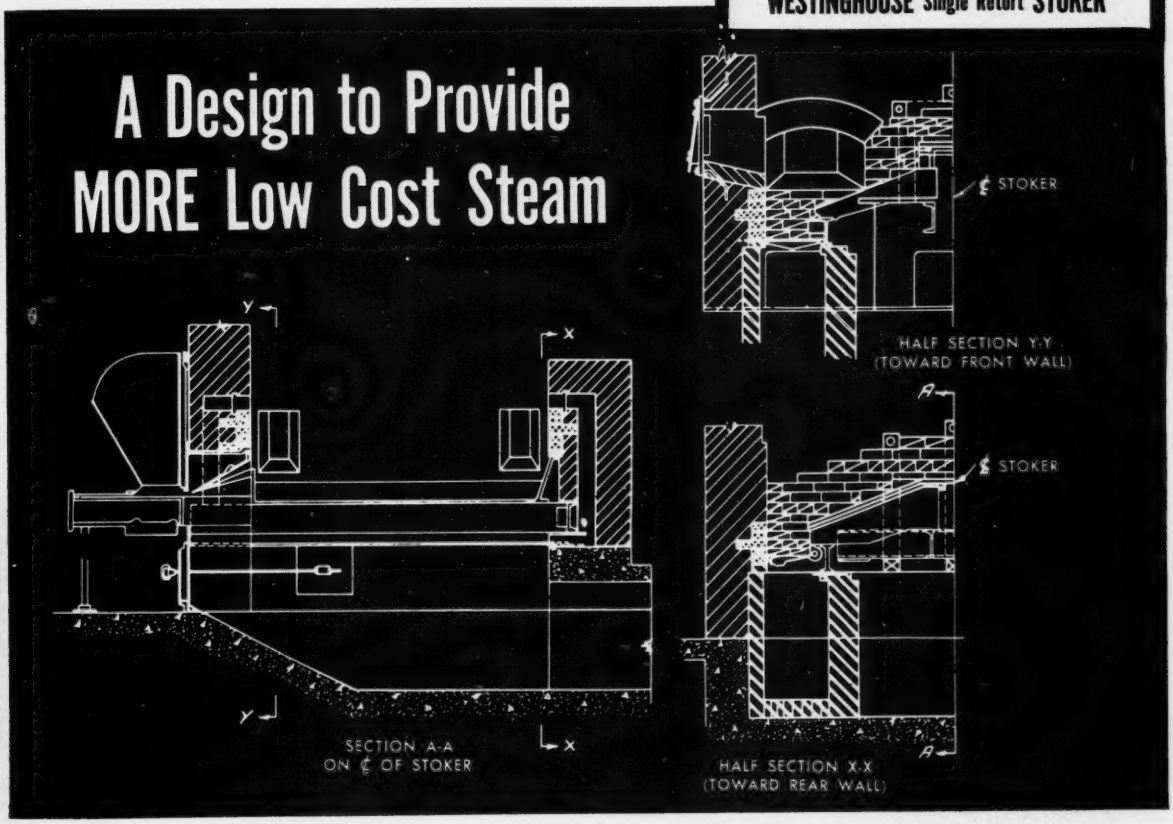
Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

A Design to Provide MORE Low Cost Steam

WALL BRICK DATA

WESTINGHOUSE Single Retort STOKER



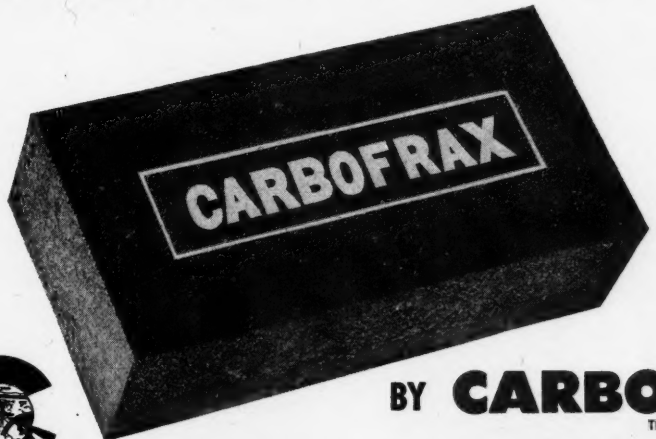
Utilizing unique characteristics of CARBOFRAX silicon carbide lining advantageously, the installation shown here is specifically engineered for use with a Westinghouse stoker. In operation, height of the CARBOFRAX wall brick coverage will be determined by conditions encountered. More low cost steam with little or no maintenance is a predetermined certainty.

Increased steaming capacity is attributed, in part, to the clinker resistance of CARBOFRAX brick. Their hard dense surface, retained at elevated operating temperatures, successfully discourages massive clinker formations. The few that may remain are quickly and easily barred off. The entire grate area is available at all times. Fuel burns more efficiently and economically.

Also contributing to production economy is the extreme durability of CARBOFRAX brick. Offering as much as eight to ten years or more of steady on-line service, they require practically no attention. Repair costs are pared to a minimum. The upper walls, too, last longer with less care because of the excellent foundation provided by the erosion resisting CARBOFRAX brick. Thus an additional saving is effected.

The excellent refractoriness, high hot strength and imperviousness to abrasion make CARBOFRAX brick an ideal lining material for boiler furnaces. Our engineers will be glad to work with you in planning an installation to obtain more steam cheaper. Address Dept. H-126 for additional information and factual literature.

The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



BY CARBORUNDUM
TRADE-MARK

Christmas Seals

. . . Your Protection Against Tuberculosis

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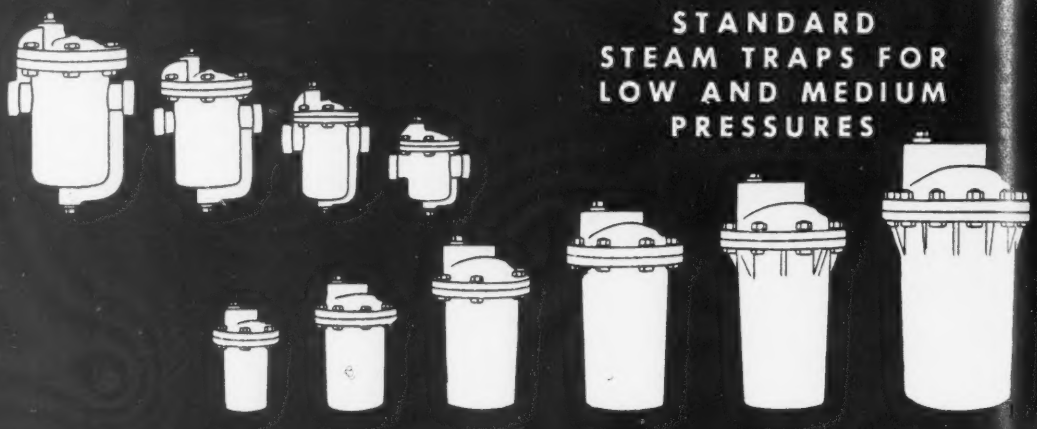


STANDARD
STEAM TRAPS FOR
LOW AND MEDIUM
PRESSURES

THE ARMSTRONG line

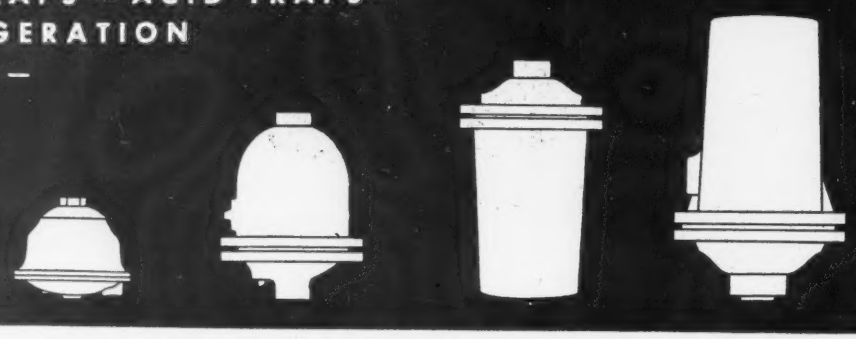
Armstrong traps are built to meet specific needs — to solve particular problems. In each case, there is a reason why one Armstrong trap is THE BEST TRAP FOR THE JOB! This is one of the underlying reasons for Armstrong's leadership when it comes to traps. It is also your assurance of COMPLETE SATISFACTION.

Take advantage of the service Armstrong offers. Factory trained representatives are located in principal industrial centers throughout the country. They stand ready to give you authoritative recommendations on how to use traps to IMPROVE PRODUCTION

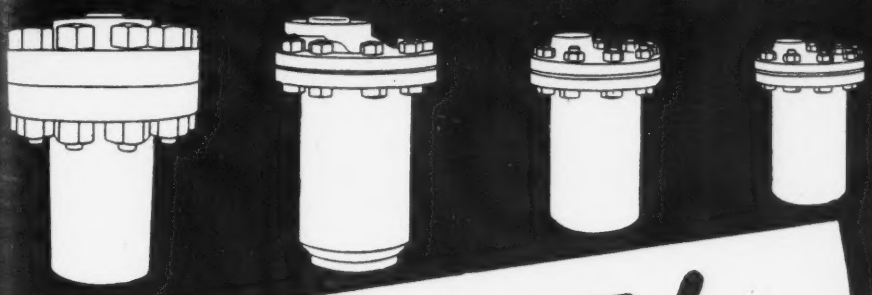
TRAPS for

SEE OUR CATALOG IN SWEET'S

AIR TRAPS — GASOLINE WATER TRAPS —
OIL TRAPS — ACID TRAPS —
REFRIGERATION
TRAPS —



FORGED STEEL TRAPS FOR HIGH PRESSURES



See our exhibit at the 17th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, Dec. 2 to 7, 1946.

is COMPLETE!

EFFICIENCY . . . REDUCE FUEL COSTS . . . PROTECT STEAM EQUIPMENT . . . ELIMINATE MAINTENANCE NUISANCE. Armstrong stock jobbers and agents extend Armstrong service around the world.

These are not the only reasons for using Armstrong traps. For the complete story, see your local Armstrong representative, or write.

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Mich., U.S.A.

ARMSTRONG
TRADE MARK
"INVERTED BUCKET"
STEAM TRAP

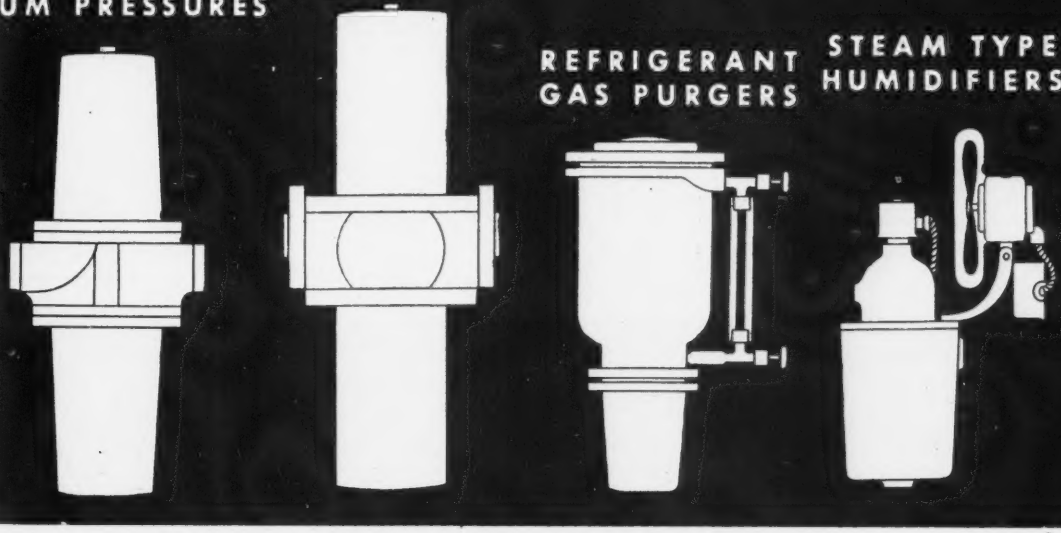
EVERY PURPOSE!

COMPOUND TRAPS FOR HIGH PRESSURES

LOW AND EDIUM PRESSURES

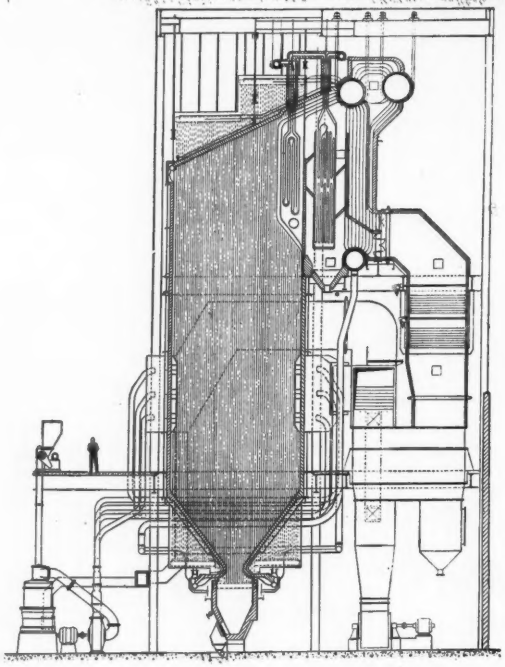
REFRIGERANT GAS PURGERS

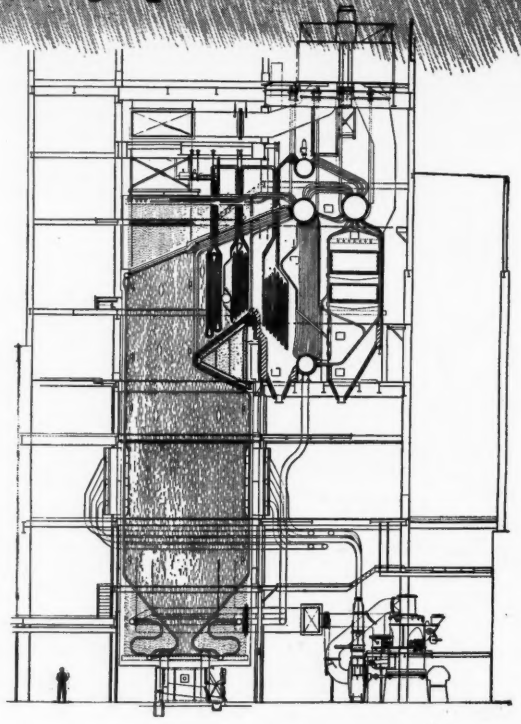
STEAM TYPE HUMIDIFIERS

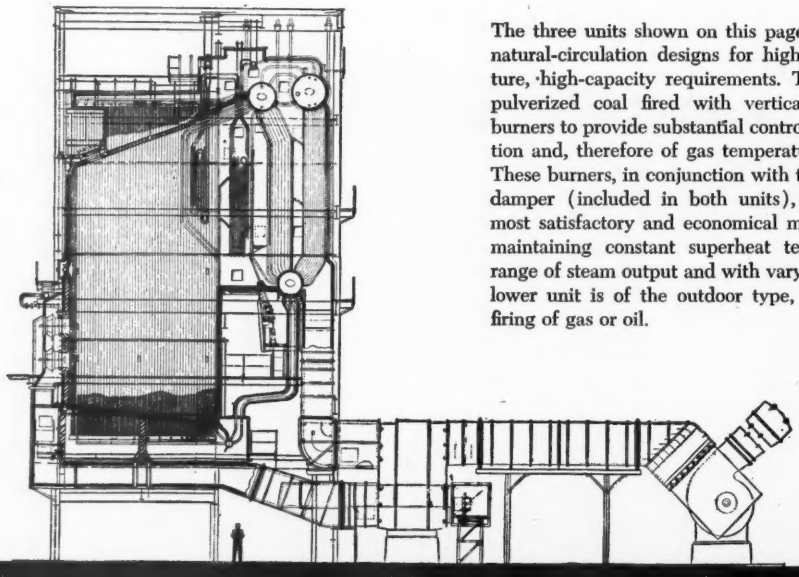


PRINCIPAL PRESENT-DAY DESIGNS

. . . for utility plants







The three units shown on this page typify present-day C-E natural-circulation designs for high-pressure, high-temperature, high-capacity requirements. The two upper units are pulverized coal fired with vertically-adjustable tangential burners to provide substantial control of furnace heat absorption and, therefore of gas temperatures leaving the furnace. These burners, in conjunction with the Montaup type bypass damper (included in both units), have proved to be the most satisfactory and economical method yet developed for maintaining constant superheat temperature over a wide range of steam output and with varying coal quality . . . The lower unit is of the outdoor type, equipped for horizontal firing of gas or oil. B-101

C-E

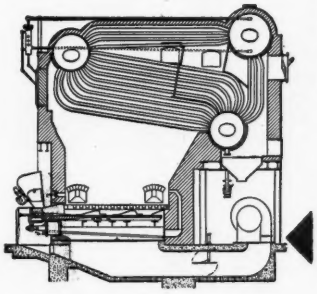
COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

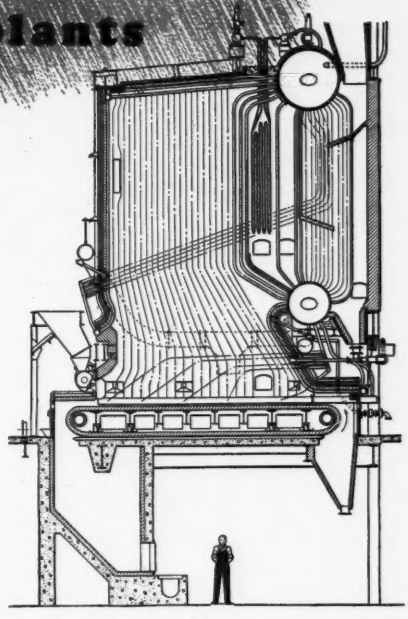
OF C-E STEAM GENERATING UNITS

. . . for industrial plants

Here are seven designs of C-E Steam Generating Units which are finding wide favor among present-day buyers. Collectively, they meet all capacity requirements – from 5,000 to 1,000,000 (or more) pounds of steam per hour – and virtually all conditions of pressure and temperature. Each unit is designed to meet modern standards of performance not only in terms of fuel-burning efficiency but also with respect to such important factors as reliability of operation and low maintenance . . . While not completely representative of the C-E line of boilers and fuel-burning equipment, these units are applicable to the vast majority of today's steam generating needs.

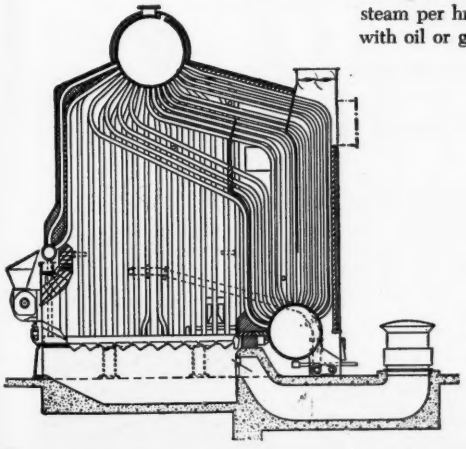


Type VM (Low Head) Boiler fired with Type E Stoker; also adaptable to other types of firing. Built for capacities ranging from about 5,000 to 35,000 lb steam per hr.

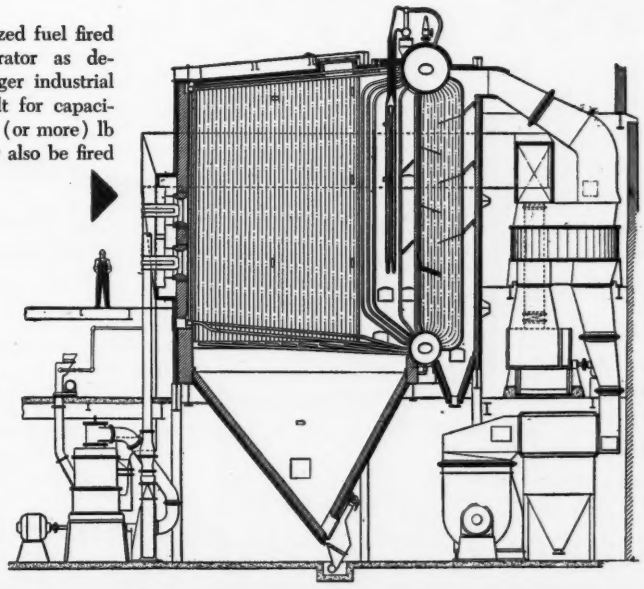


VU Steam Generator fired with C-E Continuous Discharge Spreader Stoker; capacities up to 250,000 lb per hr. Also adaptable for firing by other types of stokers, oil or gas with capacities from 20,000 lb up.

C-E Package Boiler fired with C-E Spreader Stoker; also available with Type E Stoker and for oil or gas firing. Capacities range from about 15,000 to 40,000 (or more) lb per hr.



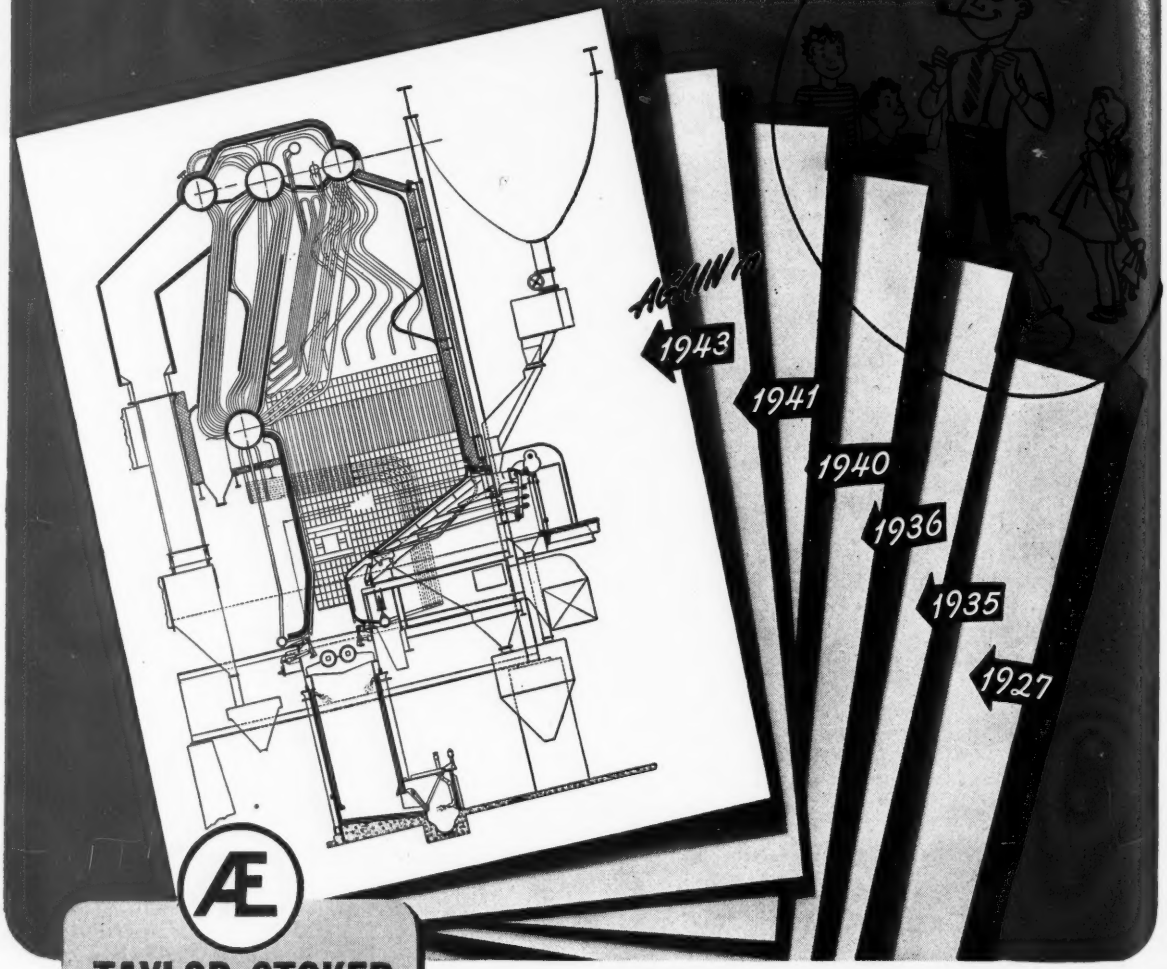
Typical of pulverized fuel fired VU Steam Generator as designed for the larger industrial requirements. Built for capacities up to 300,000 (or more) lb steam per hr. May also be fired with oil or gas.



E N G I N E E R I N G

200 MADISON AVENUE, NEW YORK 16, N. Y.

Repeat Orders PROVE PERFORMANCE



TAYLOR STOKER

AIR-COOLED & WATER-COOLED

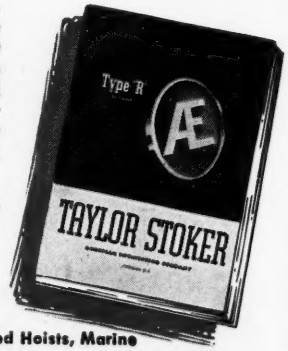
The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

One of the country's largest chemical manufacturers is a consistent user of Taylor Stokers. They have installed 11 Taylor Stokers, the first in 1927, generating a total of 1,500,000 lbs. of steam per hour. When a new plant was built to increase production, they again turned to Taylor Stokers. These units are water cooled Type R, have a continuous capacity of 180,000 lbs. per hour and burn strip coal.

Get the Facts on the Improved Type R

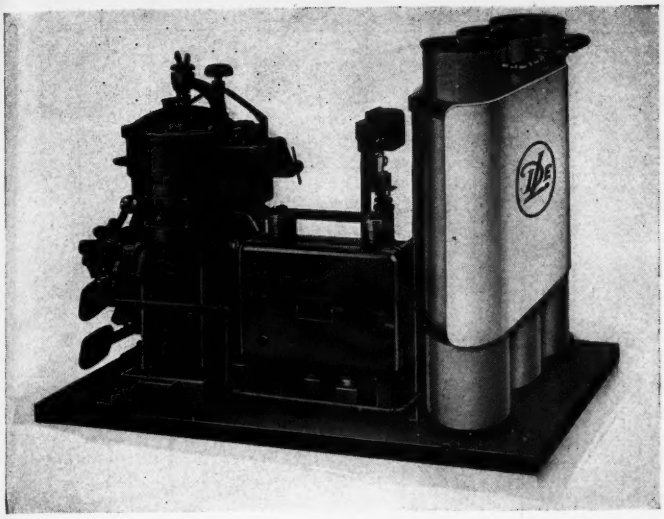
This easy-to-read 18 page bulletin will quickly bring you up-to-date on the advantages and improvements in stoker operation as provided by the Æ Taylor Stoker. Write for it!



Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

AMERICAN ENGINEERING COMPANY

2408 ARAMINGO AVENUE, PHILADELPHIA 25, PA.



NEW-

DE LAVAL "PURI-FILTER" FOR PURIFYING DIESEL LUBE OIL

Centrifugal Purification PLUS Micronic Filtration

Note these Features

1. **Removes dirt and water by centrifugal force**
2. **Filters out harmful carbon**
3. **Does not remove valuable additives**
4. **Cleans oil at moderate temperature**
5. **Speeds up inspection—crankcase is cleaner**
6. **Minimizes ring sticking**
7. **Increases bearing life**
8. **Saves labor—long runs without bowl cleaning**
9. **Increases oil life**
10. **No dirt . . . carbon . . . or water**

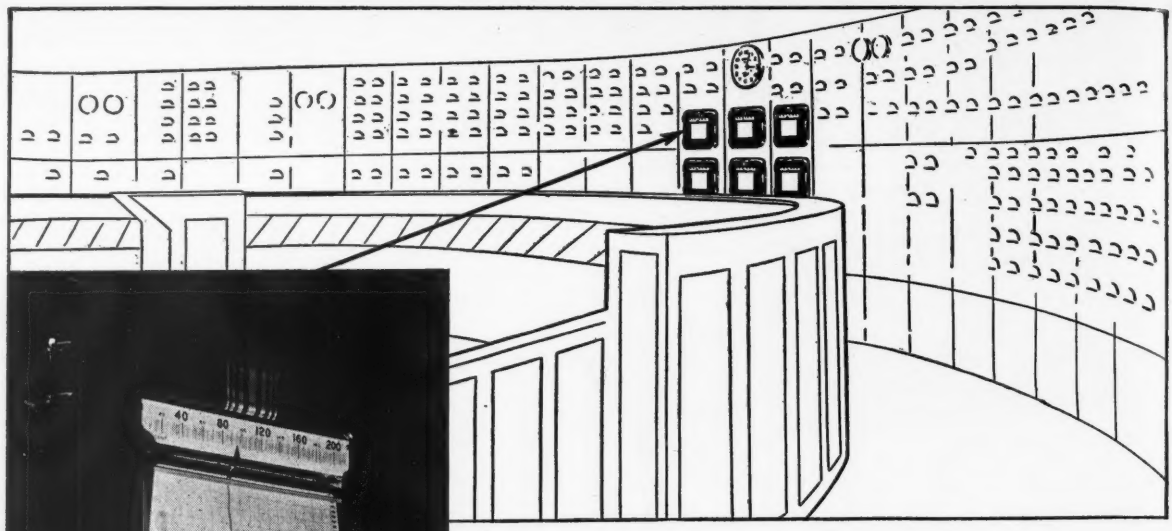
THE De Laval "Puri-Filter" is a combination of the De Laval "Uni-Matic" Oil Purifier and the Fram "Filcron" Filter. The unit is complete with dirty-oil and clean-oil pumps, and is piped, ready to operate. Electrical controls are provided, and all parts are compactly mounted on a sturdy metal base.

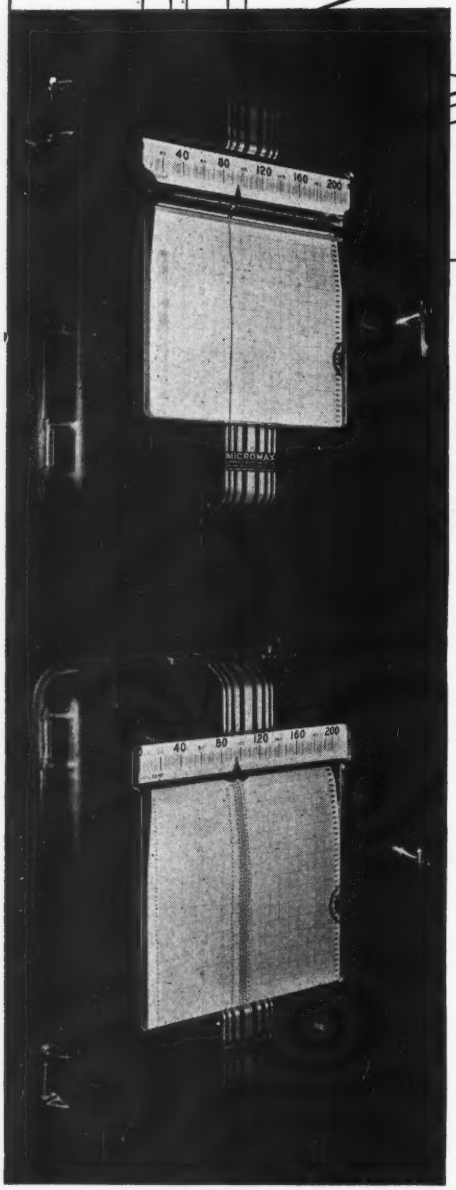
The De Laval "Puri-Filter" enables the Diesel operator to secure the advantages of purifying Diesel lubricating oil by centrifugal force ***and*** by positive filtration. Heretofore he has been forced to choose between centrifugal force, which removed most solid impurities and all water, and filtration, which in cleaning the oil also restored a good measure of color, but which provided no protection against water. With the "Puri-Filter", Diesel lubricating oil can be maintained truly ***clean*** and ***dry***—the maximum in protection for every engine. Ask for Bulletin D-1.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
PETERBOROUGH
QUEBEC MONTREAL WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

FOR DIESEL LUBRICATING OIL





The Record of a Micromax Helps with New Operators

When a power station's operators are inexperienced or extremely busy, the shift engineers particularly appreciate the "insurance policy" value of Micromax Recorders for stator and rotor temperature. For, whereas a new man—especially an interested, conscientious man—may miss something in trying to deduce the temperature from the power factor and load readings, the Micromax doesn't do any deducing. It measures and records the temperature directly, and can sound a gong to rouse the whole station if the machine starts to overheat.

Characteristic of Field Recorder

Because a generator's field may change in temperature more rapidly than does the stator, the Micromax Field Temperature Recorder is sometimes a more sensitive guide than the Stator Recorder, especially under conditions of poor power factor. Then, too, the Field Recorder is a single-point instrument, giving a continuous record, whereas the Stator Recorder periodically measures 8 points.

Characteristic of Stator Recorder

The fact that the Stator Temperature Recorder does take an overall look at the temperature at various points in the windings, however, makes many engineers prefer it; so that complete protection against over-heating usually requires both field and stator recorders.

Both of these Micromax Recorders are described in Catalog N-33-161, "Micromax Temperature Instruments for Electric Power Equipment," which is sent on request.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

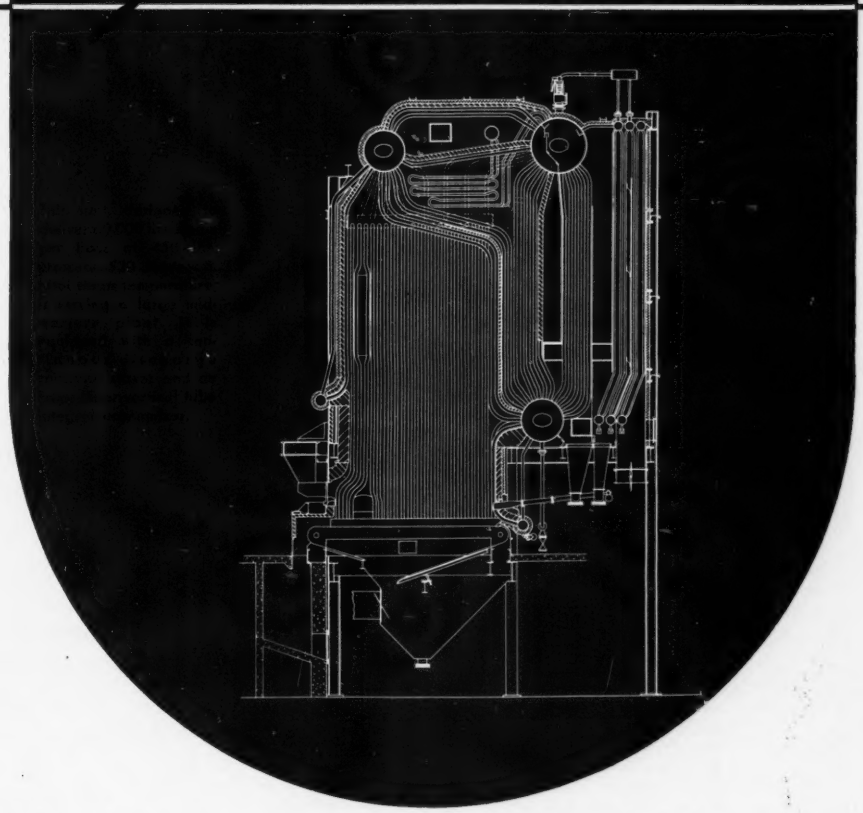
LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl. Ad N-33-161(6a)

Edge Moor Radiant Boiler

MAXIMUM PERFORMANCE



Here is a boiler which gives you *maximum performance* with respect to continuity of service, dependability, and over-all operating efficiency . . . your assurance of greatest investment return. It's the result of Edge Moor design . . . design which embodies the principles of modern steam generation to bring you every desirable feature you want in a boiler.

- ***Design flexibility permits most favorable use of available plant space.***
- ***Steams quickly and delivers continuous high ratings.***
- ***3-drum grouping affords large water space, generous steam liberation surface, quiet offtake drum.***
- ***Furnace cooling arranged for minimum of maintenance and efficient operation.***
- ***Adaptable to all fuels.***

Edge Moor Radiant Heat Boilers are available in a wide range of capacities, pressures and total temperature requirements, and can be supplied with all boiler auxiliaries.

EDGE MOOR IRON WORKS, INC. Main Office and Works: Edge Moor, Del. Branch Offices and Agents: 95 River Street, Hoboken, New Jersey • 7 Water Street, Boston, Massachusetts • P.O. Box 9, Station E, Atlanta, Georgia • 2459 Woodward Avenue, Detroit, Michigan • One N. LaSalle Street, Chicago, Illinois • 2295 University Avenue, Saint Paul, Minnesota • 623 Aztec Building, San Antonio 5, Texas • 141 Second St., San Francisco, Calif.

edge moor eam generating equipment

EM

BUILDINGS AND BUILDING MANAGEMENT

Substitute Management

In talking with building managers about their problems and policies, we occasionally encounter managers who seem to take pride in knowing very little about the physical operation of their properties. The inference, presumably, is that they are personally too important to know much about such things as maintenance, rehabilitation and repairs.

Were this attitude less common, it might be laughed off as an amusing pose intended to impress visitors, but it is too widespread to be dismissed so lightly, and it seems to be spreading. Perhaps this is perfectly natural. It is hard to get very excited about efficient operation and tenant service when buildings are full, and resentful tenants have nowhere to go. It is much easier to sit back and let someone else operate the building, and that's exactly what many building managers seem to be doing.

They have forgotten, apparently, that efficient operation is the chief difference between building management and real estate brokerage. Any broker could rent space and collect rents in today's market, but most brokers would have difficulty in operating buildings successfully. That's why owners hire professional building managers. Otherwise, a real estate broker would do just as well, and be less expensive.

Actually, of course, a sound personal knowledge of building operation is one of the building manager's best tools in making buildings profitable. No one expects a building manager to know how to repair an elevator or build a wall or even mop a floor. That's not his job, but he almost certainly won't go far in his profession *unless he knows whether or not such work is being done properly, and whether or not his costs are in line with comparable costs in other buildings*. That is his job, and no one can do it for him.

Any building manager is, of course, thoroughly justified in delegating routine operating authority to competent subordinates — to the building superintendent, the chief engineer and others whose technical knowledge qualifies them to be department heads. But the manager who then sits back and lets these subordinates make operating policy decisions for him is flirting with serious trouble for himself, his owners and the properties under his supervision.

There is no satisfactory substitute for the building manager's brains, or for his ability to make sound operating decisions on the basis of his own knowledge. That's why he is the manager. To forget that is to invite someone else to operate his buildings in his place.

Charles McCaleb

Reproduced by permission from the September issue of Buildings and Building Management

OUR SENTIMENTS EXACTLY.. *Mr. McCaleb!*

Elevator Maintenance by the Manufacturer . . .
What better assurance of proper workmanship?

Standard rates now in effect on 30,000 elevators
What better assurance that costs are in line?

Maintenance by Otis, for Otis elevators, is available at a flat monthly rate through your local Otis Elevator Company office.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

IT'S FAST IT'S TRIM IT'S RELIABLE

G-E High-voltage LIMITAMP CONTROL

This is the back view of a factory-assembled Limitamp unit. It controls the 300/600 hp synchronous motor which drives a Banberry mixer in a rubber mill. This mill represents only one of the many different industries for which Limitamp Control, designed for severe duty, is ideally suited.

This attractive, easy-to-install unit is a single Limitamp controller.

Here is a co-ordinated control that provides *outstanding* protection for high-voltage motors.

EJ-2 FUSES cut off a rise in current, resulting from a short circuit, in less than *one-quarter cycle* and clear it in less than one-half cycle—long before the short has time to harm the contactor or motor. And this operation takes place silently—without startling workmen.

AIRBREAK CONTACTORS designed for severe repetitive service, are co-ordinated with the EJ-2 fuses. These contactors give dependable, low-cost operation with little maintenance. Operating experience has proved that they furnish reliable service with only routine inspection—*even after several million operations.*

PROVIDING OVERLOAD AND UNDERVOLTAGE PROTECTION, this control guards the motor against overheating due to sustained overloads or single phasing by isothermic overload relays which are accurately calibrated against actual motor characteristics.

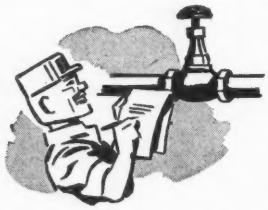
YOU'LL WANT complete details about Limitamp controllers—special features, different types of enclosures, ratings, etc. Ask our local office for Bulletin GEA-4247 or write directly to *Apparatus Dept., General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

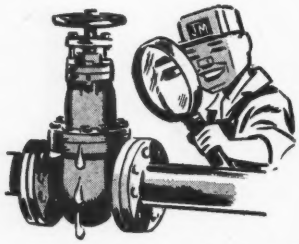
The Stuffing Box

TIPS ON GOOD PACKING PRACTICE

NO. 5 OF A SERIES

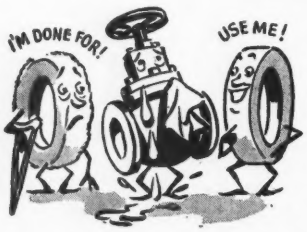


With valves—as with other equipment—frequent and regular inspection pays off in better operation and lower maintenance costs. A schedule based on the frequency of valve operation will tell you some interesting things about your equipment. Suitable forms should be used to record the results.



At the first sign of a leak . . . stop it! Leaks may occur at any joint, around stuffing boxes, at body-bonnet joints, at pipe-valve connections or at valve seats. The following figures give some idea of how wasteful leaks may be:

Fluid	Pressure	Leak Diam.	Loss per month
Steam	100 lb.	1/32"	3,200 lbs.
	100 lb.	3/8"	460,000 lbs.
Water	40 lb.	1/32"	4,800 gals.
	40 lb.	3/8"	690,000 gals.



Tightening a joint may stop a leak . . . but it won't locate the cause. Gaskets or other parts may need replacement. The stuffing box may need repacking or the seats regrinding. Stuffing box leaks are often caused by loose nuts or worn-out packing. Loose nuts can be tightened . . . but DON'T repack with worn-out packing. New packing costs much less than new equipment!

Pulling up on the gland may not stop the stuffing box leak without excessive binding of the spindle. If this happens, either open the valve full or close it (depending on the type of valve) before taking off the gland. Then remove the old packing. Clean the stuffing box, gland nose and stem thoroughly and lubricate the stem. Repack with new packing recommended by the valve or packing manufacturer.

Valve lubrication should be regularly scheduled, too. Usually once a month is often enough. Oil applied to the spindle just above the gland face, keeps the stem in good condition, prolongs the life of the packing and eliminates friction. Some valves have oil holes in the yoke cap and others a grease gun fitting through which the packing and spindle receive lubrication. Clean and lubricate outside screw threads periodically.

When you insert packing rings into the stuffing box, seat each ring separately and stagger the joints. After replacing the gland, tighten the nut just enough to seat the packing without squeezing out the lubricant. Next, slack off the nut so the packing is tight enough to prevent leakage but loose enough to permit the spindle to move easily.

Use the service your valve manufacturer offers. When in doubt, consult him about the best way to repair and reassemble valves. Give him the figure number of the valve or a complete description including type, size, metal composition, kind of seat, service, etc.

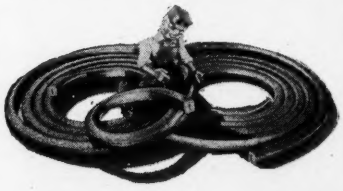
AND look for this sign—for the right packing for your job. It represents the Johns-Manville Distributors, 400 strong . . . conveniently located throughout the country and ready to supply you.

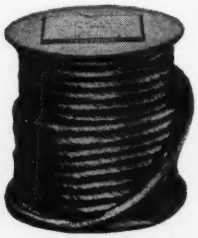
(For copies of Nos. 1, 2, 3, and 4 of the Stuffing Box series, write Johns-Manville at the address below.)

Tips on good rod and valve packings...

JOHNS-MANVILLE JEWETT

Unusually strong and tough, Jewett packing is designed for heavy-duty service against crude and heavy oils, tar, molasses and other heavy fluids.





JOHNS-MANVILLE MOGUL

J-M Mogul is a general utility packing, without rubber, that stays soft and resilient through long service . . . on valve stems, reciprocating rods, and centrifugal pumps.

Johns-Manville, Box 290, New York 16, N. Y.

For **RELIABILITY**

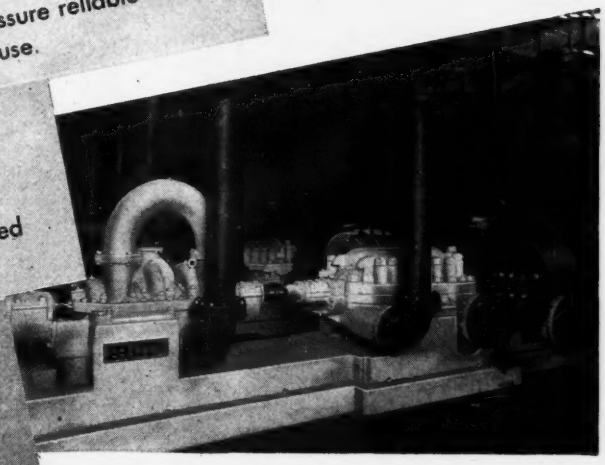
Ample clearances, high quality workmanship and proved features of design assure reliable operation over long periods of use.

ECONOMY

particularly where steam also is required for heating or process.

SPEED CONTROL

where close regulation and speed variation is desired.

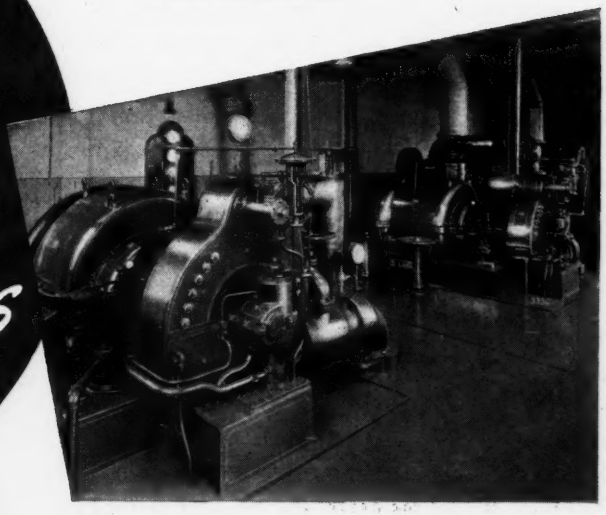


De Laval Class C Velocity Stage Turbine Driving De Laval Boiler Feed Pumps.

Install

DE LAVAL

SINGLE STAGE TURBINES



De Laval Centrifugal Compressor Driven by De Laval Velocity Stage Turbine. Exhaust Steam from the turbine is used in processes throughout the plant.

Paper Machine Driven by a 225 Horsepower De Laval Velocity Stage Turbine Through De Laval Worm Gear.

Tr-2

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

DE LAVAL

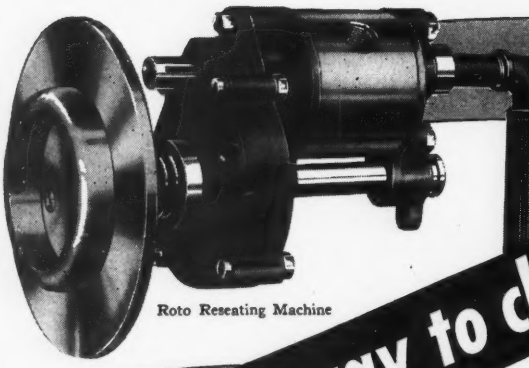
STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER • DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON • KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA • PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • TORONTO • TULSA • VANCOUVER • WASHINGTON, D.C. • WINNIPEG

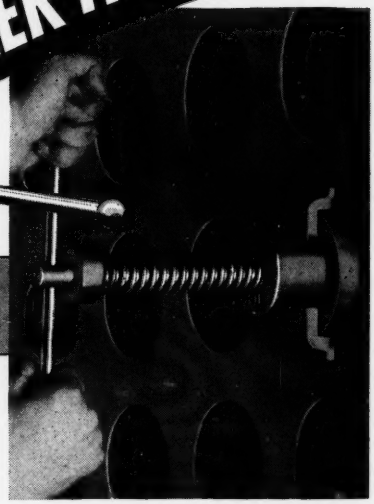
A quick way to clean BOILER HEADERS

with outside caps

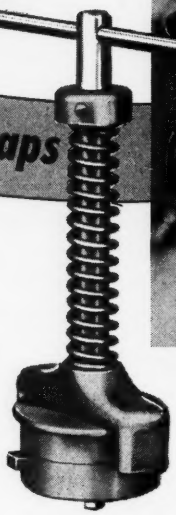
with inside caps



Roto Reseating Machine



Illustrating ease of operation of Roto Hand Hole Seat Scraper



Roto Hand-Hole Seat Scraper for Heine Boiler Headers

Roto offers you a quick, easy means of assuring tight, leak-proof joints between boiler headers and caps. The Roto Reseating Machine removes scale, rust or other adhering matter from headers with outside caps and provides a smooth, true fit.

For boiler headers with inside caps Roto offers a simple hand-hole seat scraper which cleans either round or oval holes. These machines have been used widely for many years, and are sold on a money-back guarantee of satisfaction.

ROTO RESEATING MACHINE

This air-driven machine cleans headers and caps with an abrasive cloth disk fastened to a flat surface plate whose pilot ring accurately centers the disk on the gasket seat. Caps are cleaned by fastening the machine in a vise and holding the cap against the disk. Three pilot rings are furnished; one for the header and two for cleaning both sides of the caps.

The inexpensive abrasive disk is easily replaceable when worn, assuring a true grinding surface at all times. The machine is light (10 lbs) and convenient to handle. It develops 1 hp at 5,000 rpm, and is geared down 5 to 1 to provide ample torque. Send for details and prices.

NOTE—This machine can also be used for cleaning ½" to 1½" condenser tubes by simply removing the surface plate and attaching Roto Extension Shafting with a fluted drill or wire brush.

ROTO HAND-HOLE SEAT SCRAPER

This simple, hand-operated tool consists of a cutting head with retractable cutters, mounted on the end of a revolving spindle having a bearing in a substantial yoke. An adjustable spring automatically maintains tension on the cutters, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right and the job is done. A half turn to the left releases the machine.

Roto Scrapers are available for standard round or oval holes. Minor adjustments make them suitable for special sizes or conditions. Write for details and prices.

Make of Boiler	Tube Size	Opening
Babcock & Wilcox	4"	Oval
Babcock & Wilcox No. 40 Header	3¼"	Oval
Babcock & Wilcox No. 41 Header	2"	Oval
Babcock & Wilcox Superheater	2"	Round
Edge Moor	4"	Oval
Heine	3½"	Round
Keeler	4"	Round

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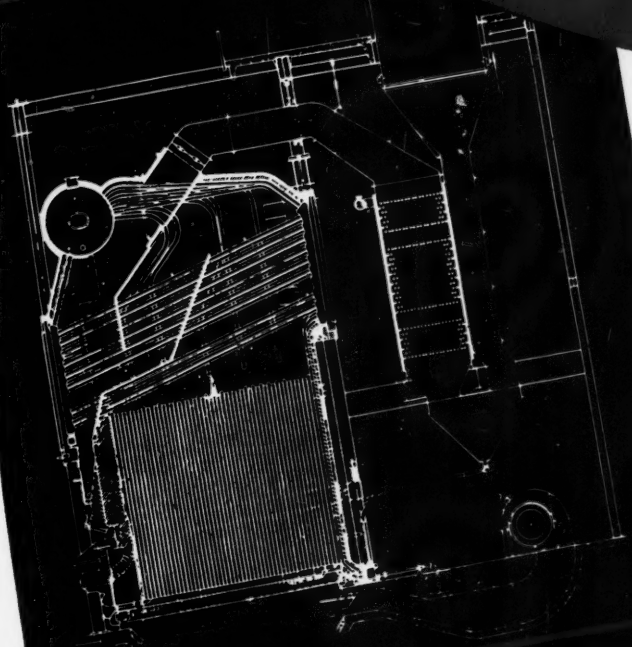
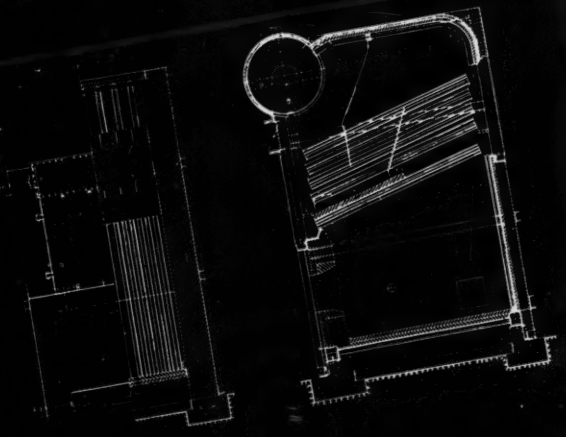
- SUPERHEATERS.
- AIR PREHEATERS.
- ECONOMIZERS.





The Springfield organization is devoted exclusively to the production of modern, high efficiency boilers and their associated parts. This singleness of purpose and specialization is your assurance that your job will get attention second to none when placed in Springfield's hands. No one has ever questioned the quality of the Springfield product or the willingness of the maker to stand back of installations to the fullest degree. THERE IS A REASON. Regardless of whether you specify it or not, every Springfield unit has built into it extra margins of safety . . . extra operating and maintenance conveniences . . . extra durability. When you have to live with a boiler plant a long time, these *plus values* are remembered long after any difference in first cost is forgotten.

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HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS

1 **All Welded Boiler**—7-page Catalog 89 in color, punched for loose-leaf filing, describes the company's new Hi-Test Series HT two-pass portable tubular boiler with refractory-lined firebox. This boiler comes in six sizes, 50 to 150 hp, 125 and 150 psi and is the first all welded unit built by the company. The bulletin is well illustrated with diagrams and photographs of the boilers. Full specifications are given and dimensions tabulated in detail. Kewanee Boiler Corp.

2 **Double-Pass Boilers**—Double-pass firebox boilers are described in Bulletin No. RM-1 (Sixth Edition); the bulletin contains 8 pages. A description of the outstanding advantages of the units . . . various fire tube layouts, liberal furnace volume, accessibility, etc. . . . is followed by photographic and dimensioned drawing illustrations. Three pages of complete specifications in tabular form, accompanied by cutaway dimensioned drawings, present a huge amount of engineering information. The Brownell Co.

3 **Steam Generator Bulletin**—The company's S Type steam generator is described in Bulletin 119, a four-page catalog. Several photographs of the boiler are shown and a drawing of the unit with a table of sizes and dimensions is accompanied by a line drawing. The adaptability and construction of the unit are thoroughly explored in the text of the bulletin. Union Iron Works.

4 **Power Boilers**—4-page Form No. 5140T describes the company's line of scotch marine power boilers. Included in the bulletin are tables of specifications and dimensions for oil and gas fired boilers, hand fired boilers and stoker fired boilers with detailed line drawings of each. The last page contains a group of photographs showing the various types of boilers loaded for shipment. Struthers Wells Corp., Titusville Boiler Div.

5 **Bent-Tube Boiler**—This 16-page bulletin in color describes the company's Class VL water tube boiler. The bulletin is effectively illustrated with several photographs and numerous diagrams of actual installations with brief installation data. The last page gives four typical design diagrams of the company's water cooled wall construction. Henry Vogt Machine Co., Inc.

6 **Scotch Boilers**—Scotch dry back boilers are described in this 12-page bulletin. Tables of boiler dimensions and line drawings of the units are presented in the fore part of the booklet. One full, extended page is employed to show a cross-sectional drawing of the unit and to point out some of the construction features. The remainder of the bulletin shows photographs of installations in drug companies, textile mills, cold storage plants, laundries, etc. Dominion Bridge Co., Ltd.

AUXILIARIES, ACCESSORIES

7 **Dust Collector**—This publication is a small folder entirely devoted to a listing of the advantages of the company's cloth bag type dust collector. Three illustrations show the simple, efficient and economical manner in which the equipment works and brief descriptive material is also presented. Typical installations are shown. American Foundry Equipment Co.

8 **Underfeed Stoker Firing**—6-page Reference Bulletin No. 8, punched for loose-leaf filing, gives the results of a number of surveys conducted during the past few years on multiple retort underfeed stokers. The bulletin gives descriptions of the various types of underfeed stokers, contains a careful analysis of the factors involved in the selection of multiple retort underfeed stokers and two pages are devoted to design data and installation diagrams. Fairmont Coal Bureau.

9 **Oil Heaters**—A new 12-page catalog, No. 0-46, giving data on the construction and design of WA Tu Bo Straight Tube and U-Tube oil heaters for preheating oil in the fuel room or in large storage tanks has just been issued. The catalog contains photographs of actual installations of the heaters, gives tables of capacities and dimensions and the last page contains useful information such as classification of fuel oil, properties of fuel oil and pointers on the correct installation procedure. Water Tube Boiler and Tank Co., Inc.

10 **Draft Production, Dust Collection**—This 20-page catalog 200 is devoted to a description of the company's line of draft producing and dust collection equipment. Detailed descriptions of the company's fans and fan stacks are amply illustrated. Supplementing the dust collector information is material on a recently developed dust collector designed for higher efficiency. Additional material is included on specific installation problems. The Thermix Engineering Co.

11 **Coal Crushers**—There are 40 pages in this recently-issued booklet on coal crushers, Catalog 784. The helpful information on these units is presented right from the first page; here is a table which lists "Desired Product," then the "Type of Machine" to use and last the page number on which you will find a description of the machine. There are 12 types of crushers described and the procedure in describing these units is as follows: For the single roll crusher, for example, the description shows where these units may be most profitably employed and then tells about its features of construction and operation. Details of construction are next given as are descriptions of safety devices and advantages of the unit. Next is given a table of sizes and capacities of the unit with hard, medium hard and soft bituminous coal. The other types of crushers are similarly described. The last section of the booklet presents some excellent photos of installations. The Jeffrey Mfg. Co.

12 **Evaporators Booklet**—Bulletin AP-1 is a 20-page issue which covers the engineering and construction of the company's "Flex-Tube" evaporators. The construction of the evaporators is exhaustively discussed in the booklet; line drawings of cross sections of the unit are presented and drawings of detailed construction parts are dealt with extensively. All major parts of the unit are named on a cut-away wash drawing. Other drawings include flow diagrams of installed units. American Locomotive Co., Alco Products Div.

13 **Steam Condensers Handbook**—There are 42 pages in this recently-issued Catalog No. 1461. The booklet leads off with complete descriptions of construction details of its line of steam condensers of all types and sizes. The units are well illustrated and the photographic illustrations are large and clear. Among the types described are dual bank surface condensers, vertical type surface condensers, marine type, low level jet condensers, barometric jet condensers, and condenser pumping equipment. The back part of the book contains much engineering information in tabular and chart form. For instance, tables of tube characteristics, free dry air leakage, atmospheric relief valve sizes, suction lift in feet of water, etc. Many of these tables are accompanied by charts. Then, too, there are full pages of pressure-temperature conversion tables and logarithms. C. H. Wheeler Mfg. Co.

14 **Vacuum Cleaners**—Two new four-page bulletins on vacuum cleaners for boilers and furnaces have just been issued. Bulletin No. 137 describes a stationary vacuum cleaning unit for removing soot from return tubular or sectional boilers and Bulletin No. 117 describes a portable vacuum cleaning unit for furnaces and boilers. Both bulletins contain photographs showing the equipment in action, with sectional diagrams and drawings of the cleaners. Furnace cleaner specifications are also given. The Spencer Turbine Co.

CONTROLS, INSTRUMENTS

15 **Vibrating Reed Tachometer**—Bulletin 1810, containing 20 pages, is a small text book on the construction and use of "Frahm" tachometers for indicating speed and rate of vibration. The first two pages deal with the overall features of the instruments and illustrates them with photos. Next comes an explanation of the principle of resonance and features of construction. Accuracy of reading and directions on how to check for accuracy are given and complete instructions on reading of the scale are given. "Ranges and How They are Selected," tables of specifications, and illustrations and descriptions of other speed measuring instruments are more highlights of the booklet. James G. Biddle Co.

16 **Remote Indicating and Control Systems**—What these are and what they are capable of accomplishing are explained completely and concisely in this new 12-page bulletin, 14B6641. Explanations of how the transmitter, receiver and indicator of such systems are constructed, how they work, their important advantages and specifications are graphically presented with photographs, two-color drawings and charts. Applications of these instruments in the power, oil, metal, marine and other industries are told. Allis-Chalmers Mfg. Co.

17 **Electric Control Devices**—Bulletin 100,000 is an 8-page catalog of the company's line of electric control devices such as a-c and d-c motor starters, speed and voltage regulators, resistors, ring and plate rheostats, switches, etc. Thumbnail descriptions of the various devices are presented as are photos of each piece of equipment. Several tables of sizes and capacities are also given. Ward Leonard Electric Co.

18 **Temperature Control**—Straight line temperature control instrument is described in this 4-page bulletin issued recently. Besides a listing of the features of the unit the bulletin points out how the instrument should be installed and calls attention to its simple design, easy installation and accurate operation. A table of "temperature anticipator features" is another useful section of the bulletin. A list of a few typical applications is given. Claud S. Gordon Co.

19 **Boiler Feed Control**—Bulletin No. 463 is a 16-page booklet, with a separate paper cover, dealing with the boiler feed control systems at Westover, Greenidge and Jennison Stations of New York State Electric and Gas Corp. Excellent photographs, drawings and tables of significant data for each of the three stations are presented. One full page of steam flow and water level charts is presented also, for each of the three stations. Northern Equipment Co.

20 **Temperature and Pressure Instruments**—50-page Catalog No. 101-H covering the company's complete line of instruments has just been issued. Listed are: various types of industrial thermometers, laboratory thermometers, hydrometers, indicating thermometers, recording thermometers, recording gages, temperature and pressure controllers, self-regulating regulators, pressure gages, traps, air filters, etc. Each piece of equipment is shown by a small line diagram. Also included are tables of sizes; list prices and a table of results of ASTM tests upon these instruments. H. O. Trerice Co.

21 **Diaphragm Motor Valves**—This four-fold bulletin is a unique presentation which points out the new features and advantages of this company's diaphragm motor valves. The center spread of the folder is the most interesting feature of the bulletin; it opens to a 17 by 22 in. size and the entire area is devoted to showing a cross-sectional wash drawing of a typical valve. Every part is named on this drawing and the features of construction are pointed out. Kieley & Mueller, Inc.

22 **Control Valves Engineering Booklet**—There are 44 pages in this comprehensive booklet on control valves; the booklet is bound in a separate heavy paper cover and is well indexed for easy, quick reference. This Catalog 301 presents several pages of engineering information including valve flow coefficients, flow character-

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istics, and flow curves. The remainder of the booklet covers details of construction, materials, selection of valve (which also presents much information of an engineering nature), details of handwheel assembly, dimensions, including tables of dimensions and dimensioned line drawings. Mason-Neilan Regulator Co.

23 **Micrometers**—A well illustrated 8 page bulletin describing Scherr micrometers is now available. The folder discusses the company's manufacturing methods and announces that all micrometers in the one, two and three inch sizes are now provided with a ten thousandths inch vernier without extra charge. The bulletin illustrates various inspection procedures such as checking parallelism and flatness of spindle end and anvil, describes the outside models in sizes from 0 to 6 in., inside and depth micrometers, and sets of micrometers in both English reading and metric types. George Scherr Co.

INSULATION

24 **The Cost of Heat Loss**—In this new 20-page manual for power engineers and process engineers is presented some of the most helpful information on insulation values that has ever been compiled. For example you can turn to page 18 and read from a table the dollar savings per foot of piping of various sizes which will be made as a consequence of proper insulation of bare surfaces. Division of this figure into a contractor's estimate of insulation cost yields the length of time required to pay for the insulation. Nine case histories, illustrated and described in full detail, cover a variety of typical situations in which piping, flanges, drumheads, driers and other heated surfaces were figuratively dripping with wasted fuel dollars. Actual savings in dollars are calculated for each of these examples. Baldwin-Hill Co.

25 **Low Temperature Insulation**—This company's Foamglas insulation for low temperature rooms is described in this new bulletin. The 8-page bulletin first tells what Foamglas is and also tells of its characteristics and presents a table of its physical properties. Typical applications of Foamglas in low temperature rooms are described on one page which is adequately illustrated with photos. Combination construction—corkboard and Foamglas—and a Guide To Insulation Thickness are next presented. Methods of erecting the insulation also are described. Armstrong Cork Co.

PUMPS, PIPING

26 **Underground Pipe Conduit**—4-page Bulletin 461, in 2 colors, gives an up-to-date description of Therm-O-Tile, a permanent conduit for underground pipe lines. The bulletin is well illustrated with installation photographs and line drawings, tells of the advantages of using Therm-O-Tile, describes the principal features of the product and the last page is devoted to specifications and a group of small photos showing the step by step method of application. H. W. Porter & Co., Inc.

27 **Insulated Pipe Conduit Systems**—This is a 12-page booklet in color which gives the case history of the Piqua, Ohio, Municipal Power system which several years ago went into the business of selling steam to nearby industrial plants in addition to electricity. The booklet outlines the advantages to a utility of selling steam and tells how one industrial plant was able to save over $20,000 per year in power costs by purchasing steam. The book is extremely well illustrated with photographs and blueprints, and contains cost figures and technical data. The story of the installation of underground steam conduit to serve customers is told in detail with many actual installation photographs. The Ric-wiL Co.

28 **Portable Hydraulic Pipe Bender**—9-page Bulletin No. A-7 has just been released describing the company's portable hydraulic pipe bender. The bulletin is effectively illustrated with photographs in plants where a large variety of pipe bends have been made by this pipe bender. The bulletin shows how the bender operates, gives details of construction, capacity, features and maintenance, stressing developments which make on the spot, cold bending possible. The bulletin points out that the operator of the bender has complete visibility while the pipe is bent without removing pipe from die. The bulletin includes a chart of radii of bends to center line of pipe and prices are also listed. Watson-Stillman, Distributor Products Division.

29 **Small, High Pressure Pumps**—4-page Catalog No. B346 in color describes the company's vertically split case high pressure pumps. The catalog is well illustrated with photographs and line drawings, gives details of construction, and a table of approximate dimensions and weights. The last page of the catalog contains four performance curves for 1½ x 1¼ type NAS pumps. Economy Pumps, Inc.

30 **Double Suction Pumps**—Bulletin 104, 12 pages, covers the company's double suction, single stage pumps. Details of construction are completely outlined and photos of the various parts are presented. A list of parts for these pumps is given in tabular form and is accompanied by a cross sectional drawing of the unit on which the parts are numbered. Test performance curve of the 8 in. double suction pump shows its operating characteristics. Two full pages of photos picture the pump as used in various hook ups. Frederick Iron & Steel, Inc.

PROTECTION, TREATMENT

31 **Water Demineralizers**—The company's "package unit" demineralizer is described in four-page bulletin 4266. The unit is pictured with drawings and a photograph, operation and controls of the demineralizer are listed and a table of dimensions is presented. The description points out that these demineralizers are designed for automatic production of water of a purity comparable to that of distilled water. Cochrane Corp.

32 **Protective Coatings**—4-page Folder 844-246 describes Bitumastic Hi-Heat Gray, a specialized industrial protective coating which is said to resist corrosion and temperature up to 1200 F. The folder is in 2 colors and contains several photographs of equipment on which Bitumastic has been applied. It also gives a list of uses for the material and a chart giving its characteristics. The last page of the folder contains a brief description of four other types of Bitumastic coatings. Wailes Dove-Hermiston Corp.

33 **Continuous Clarifiers**—A four page bulletin describes the company's continuous clarifier with upward sludge filtration. The bulletin contains a cross-sectional drawing showing the flow of liquid through one of these units; lists construction features which are said to assure maximum service; describes the operation of the unit, and gives a partial table of sizes. The last page of the bulletin shows a group of typical installation photographs. Graver Tank & Mfg. Co., Inc.

34 **Water Treatment Data Sheets**—A series of engineering data sheets, each covering a particular phase of water treatment, has just been issued. Subjects covered include Scale; Corrosion, After Treatment, Colloids, etc. The data sheets are designed to show clearly and simply how organic-colloidal treatment and inorganic-chemical methods respectively apply to the individual phases and problems of water treatment. American K.A.T. Corp.

35 **Automatic Proportioning**—Bulletin 1200, an attractive new 28-page catalog, has just been issued. This new catalog is a handy reference book and contains a wealth of material dealing with automatic flow responsive equipment and methods in continuous process operation. Photographs of chemical proportioning equipment and typical installations are supplemented by many flow diagrams and detail drawings. The company's method is clearly explained and the operation of the equipment is demonstrated by two-color diagrams. A complicated subject has been made surprisingly simple by the careful planning and arrangement of the bulletin. This catalog permits the purchaser to select and size equipment for most treating, sampling, blending, and diluting applications. Proportioneers, Inc.

36 **Protective Coating**—This is an 8-page technical bulletin of charts which give complete factual information on this entire line of protective coating. The bulletin gives specific recommended applications for such industries as bottling and dairy, brewing, chemical, food, marine, paper, petroleum, photographic, plating public works, sewage and water works, textile and synthetic fibre manufacturing, transportation, wine and distilling. Charts show all characteristics and properties of Amercoat plastic coatings. Also, it is a ready guide for selecting the proper coating, preparation of the surface and application methods on steel, concrete and wood. In addition, cost per square foot for materials, with area formulae, is provided. Americoat Division, American Pipe and Construction Co.

DIESELS

37 **Diesel Tractor**—New Bulletin No. MS-248A describing the company's HD-14 Diesel "crawler" tractor has just been issued. The bulletin contains photographs of the tractor in action and cutaway views of the important parts. Also included are stories on the "pusher" technique, 2 cycle Diesel power, grease-packed truck wheels, 4 way cooling and track design. Special pages are devoted to allied equipment, auxiliary attachments and specifications. Allis-Chalmers Mfg. Co., Tractor Division.

38 **Diesel Booklet**—Bulletin S-500-B42A is a 36-page issue which covers the company's Type DH Diesel engine for oil, gas or dual fuel. These pages, in the order of their appearance, show installation photographs; overall description of the Type DH unit; specifications of base, crankshaft and bearings; frame, liners and through bolts; piston, connecting rod and bearings; cylinder head, camshaft and valve gear; control systems; four-color cross section and longitudinal section wash drawing of the unit; details of air intake and exhaust systems; fuel oil handling and injection system; heavy fuel oil system; lubricating oil system; cooling water system; a Diesel engine rating chart which shows relationship of brake horsepower of the unit to its rpm. The entire book is extremely well illustrated with line drawings and photographs. Worthington Pump & Machinery Corp.

MISCELLANEOUS

39 **Flexible Couplings Engineering Catalog**—The 58 pages in this engineering catalog on flexible couplings are crammed with information, specifications and illustrations covering the company's product. The reasons for the various features of construction are clearly explained and the many different types and sizes of couplings are pictured and described. Tables are given which show dimensions of the couplings and the horsepower transmitted per 100 rpm. Applications of the couplings are also explained in line drawings. Other tables present such information as misalignment and float capacities, hp rating at service factor selected. A useful section of the booklet is the "Index to Coupling Specifications . . . " Thomas Flexible Coupling Co.

40 **Booklet on Gaskets**—A pocket-size booklet on gaskets has just been issued by this company; there are 24 pages in it. The booklet starts out with a delineation of the basic reasons why gaskets are used and why they must be safe and outlines the company's developments with these factors in mind. By means of simple, colored line sketches the entire theory and practice of gasketing is explained. The story is told with great clarity, in a highly interesting manner and "proof of the pudding" is presented in the last few pages. Flexitallic Gasket Co.

41 **Flexible Couplings Data Book**—Catalog 57 is a 20-page issue with a varnished paper cover. It contains complete engineering and catalog information about the company's line of couplings . . . gear type, Jordan type, shear pin type and others. Tables of ratings of each type are given and a complete explanation of the uses of the coupling is accompanied in each case by photos of installations. John Waldron Corp.

42 **Oil Purification**—Volume 2, No. 3 of "Clean Oil," a pictorial publication devoted to the subject of oil purification, issued quarterly by this company, is now available on request. This issue is almost completely devoted to case histories of oil purification equipment. "Clean Oil" is printed in two colors, is well illustrated and presents detailed stories which fully explain how five different companies whipped troublesome lubrication problems. Honan-Crane Corp.

(Continued on Page 160)

POWER PLANT ENGINEERING

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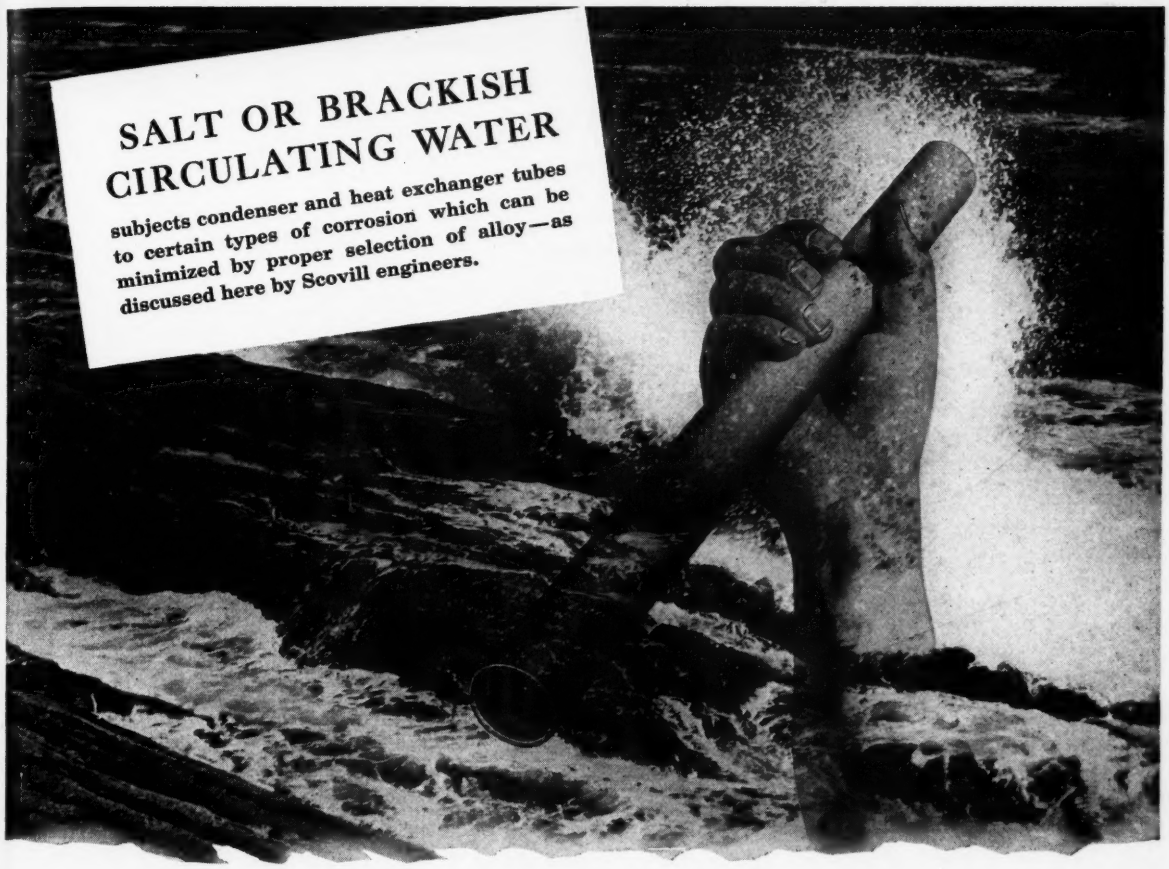
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Prolonged exposure of copper-base alloy condenser tubes to salt or brackish circulating water results in corrosion which, in certain brasses, takes the form of dezincification.

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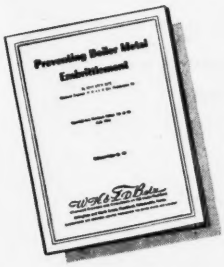

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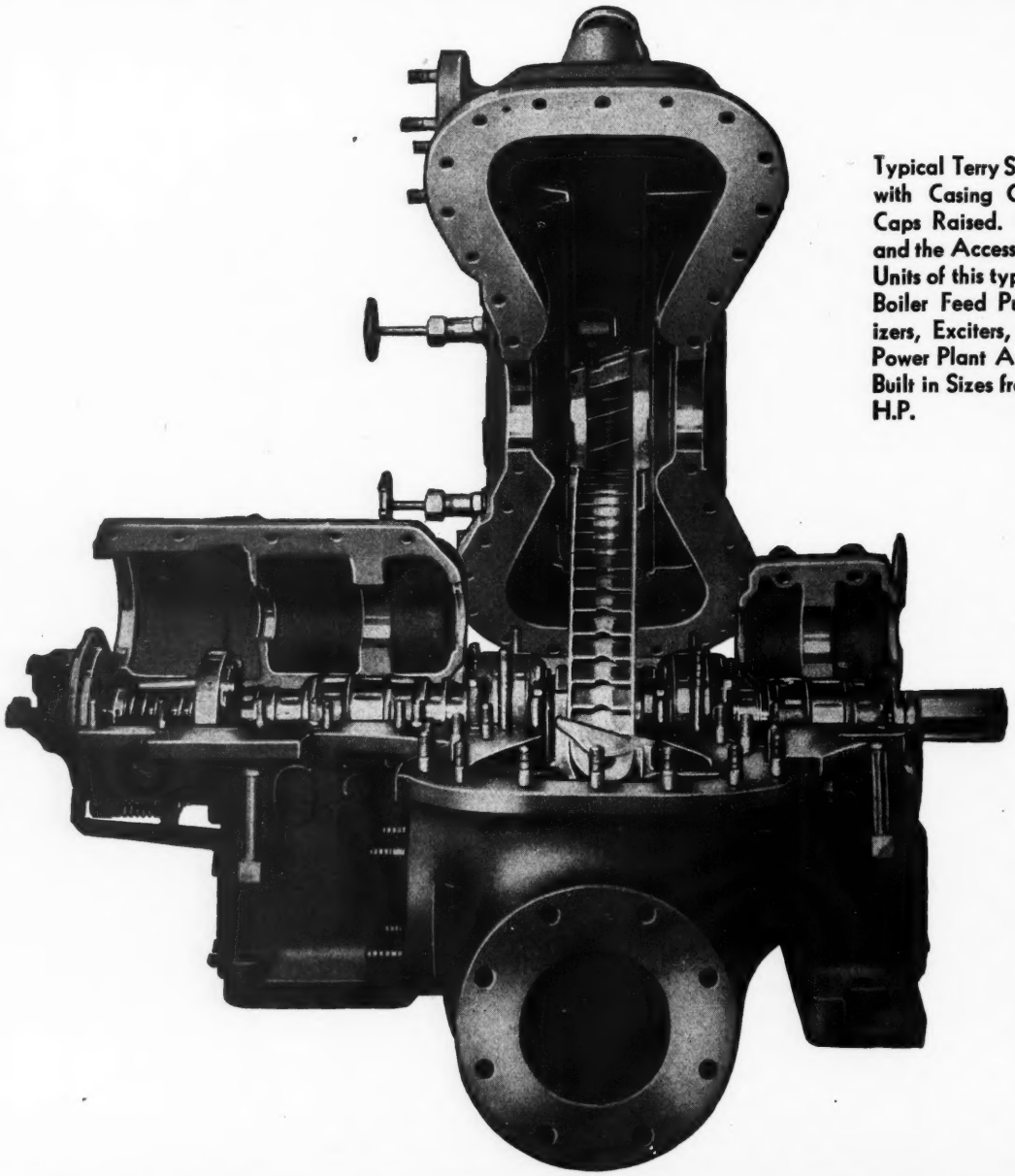

Typical Terry Solid Wheel Turbine with Casing Cover and Bearing Caps Raised. Note Ruggedness and the Accessibility of All Parts. Units of this type are used to drive Boiler Feed Pumps, Coal Pulverizers, Exciters, and All Types of Power Plant Auxiliary Equipment Built in Sizes from 5 H.P. to 2000 H.P.

THE TERRY STEAM TURBINE CO.

Wheel Turbine

E OFFERS MANY ADVANTAGES

OM THE SMALLEST TO THE LARGEST, HESE RELIABLE TURBINES HAVE —

- Indestructible One Piece Wheel
- Large Radial and Axial Clearance
- Double Rim Protected Blading
- Dependable and Durable Governor
- Heavy Dust-Proof Bearing and Governor Housing
- Independent Overspeed Trip with Separate Valve
- Sturdy Casing Design
- Strong and Easily Inspected Steam Strainer
- Sight Oil Level Gauges
- Individual Nozzle Control
- Truly Accessible Construction, Which Makes Inspection of the Interior Parts a Simple Matter

Full Details ask for Bulletin S-116

Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TERRY SQUARE - HARTFORD, CONN.

R/M FLEXIBLE METALLIC PACKING

R/M's flexible metallic packing is a new and valuable addition to the R/M line, recommended for use on steam and air rods, centrifugal pump shafts, valve stems and other applications where the temperature does not exceed 450°F., and surface speed is less than 600′ per minute.

Like a fabric packing, this packing is sensitive to gland adjustment, but it has the added advantage of non-frictional wearing surface. It is constructed of non-frictional metallic foil and asbestos yarns, combined with temperature-resistant lubricants and flake graphite. The outer layer is an open-mesh, braided cotton jacket.

This packing is typical of the engineering that goes into R/M products. For special jobs where you need packing by prescription, or for the routine work where you demand the utmost in dependability, see the authorized R/M distributor near you.

RAYBESTOS R M MANHATTAN

R M

ASBESTOS TEXTILE AND PACKING DIVISION

RAYBESTOS-MANHATTAN, INC.

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Our engineering and manufacturing facilities have been enlarged . . . our nation-wide network of agencies increased. These agencies are staffed by trained, experienced men . . . ready to give you on-the-spot service.

Warren engineers are pump specialists, having spent many years in this field exclusively, and they are in a position to give you expert, cooperative advice. WRITE DIRECT to our home office, Warren, Massachusetts, giving all possible information as to operating conditions and desired results.

P-6

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Warren Pumps

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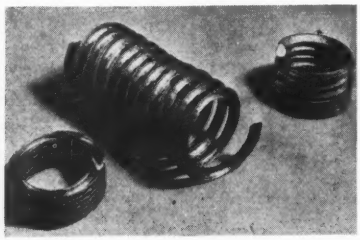
NEW EQUIPMENT NEWS

The new equipment items in this section are identified by letters which precede the headings. When further information is desired regarding any of this equipment write this corresponding letter on the coupon in the Helpful Bulletins section, cut it out and send it to Power Plant Engineering, 53 West Jackson Blvd., Chicago 4, Ill.

A Dual Edge Asbestos Packing

New in the Raybestos-Manhattan packing line is this V-shaped packing for steam or air rods, valve stems, boiler feed-plungers, hydraulic rams, etc. It is made from woven asbestos cloth

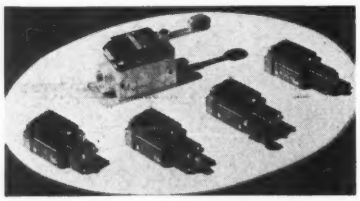


frictioned with high heat-resisting compound and moulded into a V-shape. The V-shape insures automatic sealing of high or low pressure, with a minimum of surface friction on the pressure stroke and no friction on the return stroke.

B Snap Action Limit Switches

General Electric's limit switch line has been expanded by the addition of a new small oilproof track-type switch designed for machine tool or similar applications. The switch can be used in a variety of operations through the use of interchangeable operating heads for roller-lever, roller-push-rod, push-rod, or plunger operation.

The new switch contains a single-pole, double-throw, self-contained, snap-action



control Switchette. A sturdy, molded phenolic enclosure of oilproof construction protects it from lubricating or cutting oils and compounds.

In addition to the new small switch, the standard line of track-type limit switches has been redesigned to provide such features as snap action, oilproof construction, and improved appearance.

C Clarifier For Turbid Water

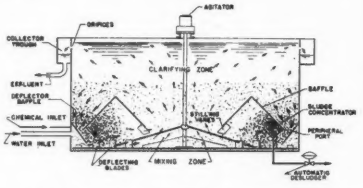
Filtration alone is insufficient to clarify water containing appreciable turbidity or color. In such cases, coagulation by means of chemicals which form jelly-like precipitates or "floc" to entrap or absorb the finely divided impurities must precede filtration.

To assure maximum effectiveness of clarification in the least time, with greatest economy of space and chemicals, Liquid Conditioning Corp. has developed the Liquon Sludge Contact Reactor. This unit efficiently combines the operations of mixing raw water with the coagulating chemicals, properly agitating the mixture, maintaining a suspended deep sludge bed or blanket of previously accumulated precipitates, completely separating the clarified water from the sludge, and concentrating the impurity-saturated sludge for minimum volume of blowoff.

This sequence of operations is accomplished by the following features:

1. The precipitated impurities which form a sludge with the coagulating or softening chemicals are positively recirculated as indicated by the arrows, so that all of the chemical in the tank is completely utilized.

2. Settling out and depositing of sludge on the floor of the tank are prevented by the large slow-moving agitator which operates over the entire bottom of the tank.



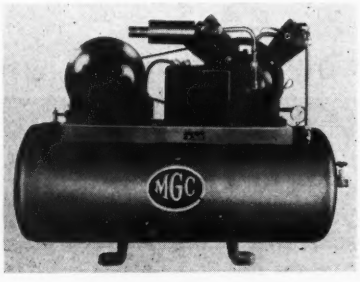
3. The clarified water is separated from the sludge by horizontal outward radial flow with gradually decreasing velocity.

4. A sludge concentrator collects and considerably thickens some of the sludge for blowoff by automatic desludging devices, keeping the top of the suspended sludge at the optimum level for best chemical results consistent with the clearest effluent.

The Liquon-Sludge Contact Reactor is equally well adapted for coagulation of turbid, colored waters, for softening of hard waters by lime-soda, for simultaneously softening and clarifying hard river waters, and for removal of iron, manganese, silica or fluorides from water.

D Two-Stage Air Compressors

Five new models of super-duty two-stage air compressors are being announced by Motor Generator Corp., a division of The Hobart Brothers Co.



These compressors will be available in 7, 9, 13 and 21 cu ft capacities and all are furnished with 80 gal storage tanks, or a 60 gal tank is optional with the 7 cu ft unit.

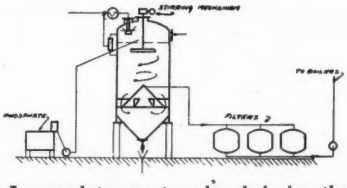
The compressors are of the self-contained type with motor and compressor mounted on a one piece steel sub-base which in turn is electrically welded to an 80-gallon horizontal air receiver. They are fully automatic and controlled by centrifugal type unloading valves which guarantee against motor burn-out.

Power transmission is direct from the heavy-duty motor by multiple "V" belts with slack take-up provided. The air pressure is automatically controlled, the pressure switch contacts closing at minimum air requirement and opening at maximum air requirement.

Both cylinder heads have deep fins, cast integral, which increases the radiating surface for dissipating the heat generated during compression of the air. In addition, a fan type flywheel causes circulation of air past a copper finned intercooler (fins drawn right in the copper thus giving one third greater radiating surface) cools the air as it passes from the low pressure cylinder to the high pressure cylinder, thus minimizing the collection of carbon in the valves and insuring greater efficiency of compressor at all times during operation.

E Stirring Mechanism Reduces Turbidity

Among the mechanical operating improvements to Cochrane Corp. precipitation type hot-process water softeners used in the external treatment of water for boiler feed and industrial processes is the development of the stirring mechanism. This agitator creates a rotary motion with the sedimentation tank and brings about an improvement in the floc formation and better sedimentation of the precipitated hardness.



Increased temperature by designing the hot-process softener for higher steam pressure and recirculation of some of the sludge accumulation from the sedimentation cone all contribute to savings in chemical reagents and increasing the efficiency of the softening process by improvement in the quality of the effluent.

The stirring mechanism is a motor-operated device in which a flat blade is rotated at the optimum speed. This speed is dependent on the sedimentation tank dimensions.. A number of tests of the stirring mechanism in many installations have indicated exceptionally fine performance with fairly hard waters and without supplemental sludge recirculation. With

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cost us LESS per Year of Service!

Fig. 2125
Bronze
Gate

Fig. 16
"Renewo
Globe"

Fig. 1430
Iron
Body Gate

In buying a valve, as in buying anything else, it's *value* you're really after.

What is the measure of valve value? Length of service, efficiency of performance, time and expense required for maintenance . . . these are the principal factors.

Lunkenheimer Valves, in these and in all other elements of value, have long proved their superior worth throughout American industry. Maintenance men everywhere rely implicitly on these *better valves* because they know they are *better values—quality-built in every detail, assuring longer* and more efficient service with the very minimum of maintenance trouble and expense.

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relatively soft waters it is recommended that sludge recirculation be combined with the stirring mechanism because the precipitated hardness may not be of sufficient quantity in itself to properly coagulate the turbidity.

The drawing illustrates the Cochrane stirring mechanism assembly as applied to a hot-process softener. The shaft is installed through the head of the sedimentation tank.

F New Gear Lubricant

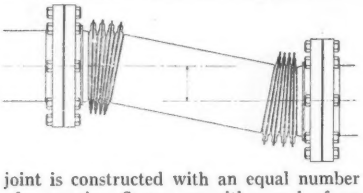
A lubricant which is easily brushed or sprayed on open gears is announced by The Texas Co. The new lubricant, called Texaco No. 2-X Fluid, contains a base material which has high adhesiveness, cut back with a non-inflammable solvent. This combination results in a lubricant which is both efficient and easy to apply.

G Offset Expansion Joints

MagniLastic, Division of Cook Electric Co., announces production of a standard line of offset joints, another in its series of packless expansion joint types suitable for all piping conditions.

This latest addition to the line fills a long-felt need for a standard flexible unit for joining pipe terminals that are out of line—or offset. This condition may be due to accumulated excess tolerances in piping sections, to settling and shifting at anchor points or hangars, thermal expansion and contraction of pipes and mountings, or to variations in operating conditions.

Severe stresses and damage may result when makeshift measures are employed to bring misaligned pipe ends together. The



joint is constructed with an equal number of expansion flanges on either end of an insert section. Length of unit and number of flanges are determined by misalignment condition to be corrected.

Offset Joints are supplied with bellows flanges from any of the MagniLastic Standard Expansion Joint series which includes pressures from vacuum to 100 psi, pipe sizes from ½ to 24 in. and temperatures from minus 300 to plus 1600 F. Joints of stainless steel, Nonel, Inconel and copper cover all common corrosive conditions. End fittings are available in welding end or Van Stone bolted flanges.

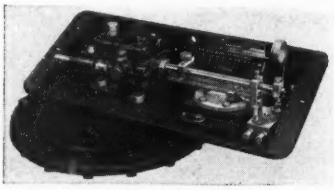
In addition to joining offset pipe terminals, these offset joints protect valves, headers and fittings from undue strain and tension.

H Adjustable Weighbeam

Republic pneumatic pressure and differential pressure transmitters can now be furnished with an adjustable weighbeam—a new development which makes possible a 15 to 1 range without change of parts. The only readjustment necessary is rebalancing for zero.

This feature is provided by replacing the standard weighbeam by a double weighbeam having an adjustable pivot between the two halves. The range of the transmitter is changed by merely sliding the adjustable pivot along a calibrated scale to the desired setting. For example: a differential transmitter having a minimum range of from 0 to 1.0 in. of water can be changed to any range up to 0 to 15.0 in.; similarly a transmitter with a minimum range of 0 to 8.0 in. can be changed to any range up to 0 to 120.0 in.

The flexibility of application provided



by this new development is of paramount importance on those installations where operating conditions are highly variable or on new installations where flow or pressure conditions are unknown. It is announced by Republic Flow Meters Co.

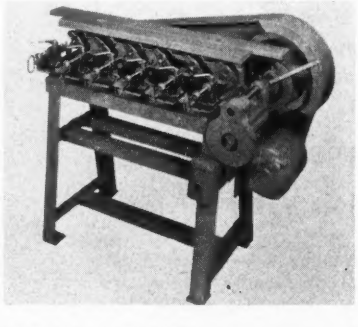
J Improved Greases

Announcement is made by The Texas Co. of improvements in their products Texaco Starfak Greases L, M, and H. Oxidation and heat resistance have been improved. Better low temperature characteristics have been obtained through the use of special highly refined, high viscosity index low pour oils.

K New Cock Grinding Machines

Milwaukee Cock Grinding Machine Co. announces two new improved six-spindle cock grinding machines designed especially to grind and lap larger sizes and a wider variety of types of tapered valve cocks. All sizes from ⅛ in. ips to 1½ in. ips, including those for steam, air, gases, liquids and railroad cutout and angle cocks are handled. They grind and lap up to 300 cocks per hour, depending upon the size of the cocks. Only one operator is required.

The machines will grind up to six different types of valves simultaneously. Each spindle is separately controlled by simple, fast operating engagement clutch, permitting each spindle to be loaded individually. Tailstock centers and tailstocks are quickly and easily adjusted and body holders can be changed quickly thus reducing set-up time. The valves while being ground are



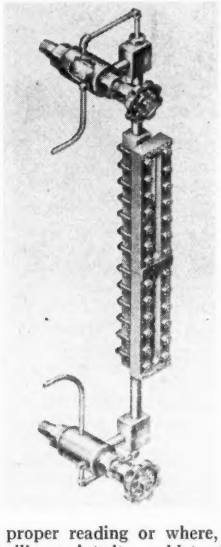
rotated in a perfectly true manner and the bodies are self-centering on the valves, thus insuring a perfectly ground valve seat.

Model B is provided with two-jaw chucks for grinding valves with flats on the stems. Model C is equipped with heat treated alloy steel collets for gripping round valve stems. Collets are available with grips up to 1 in. diameter.

L Liquid Level Gage

Jerguson Gage & Valve Co. has placed on the market a liquid level gage with an auxiliary tube through which a heating or cooling gas or liquid can be circulated for the purpose of raising or lowering the temperature of the liquid in the gage itself. The unit is available in both Reflex and Transparent types, the on illustrated being the Reflex Type. The auxiliary tube passes concentrically through the liquid chamber of the gage, thus affording intimate contact with the liquid being heated or cooled. The valves used in this assembly (No. 93) are jacketed so that the liquid when passing through them can also be heated or cooled.

Gages and valves of this type find frequent application in process plants where the liquid in the gage might be too slug-



gish for proper reading or where, because of low boiling point, it would tend to boil and thus cause incorrect readings. Such a gage is useful, too, in cold climates where the liquid in a standard gage might freeze.

Jerguson heated or cooled gages come in a full range of sizes, similar to standard gages being designed for pressures up to 3200 psi (Reflex) and 2000 psi (Transparent) at 100 F or 1200 psi (Reflex) and 600 psi (Transparent) at 1000 F. The auxiliary tube can be supplied in corrosion resisting metal.

M Servo Follow-up System

The Electronic Associates, Inc., Servo Follow-Up System differs from other selsyn transmitter-receivers in many ways. The power output is far greater.

The Model 105 system has an ountput torque of 96 in.-ounces. The same type of equipment can be supplied on special order to control up to ½ hp motors. The Model 105 has a maximum following speed of approximately 50 rpm—other speeds can be supplied on special order.

The high positioning accuracy of 0.027 per cent permits its use in critical measuring systems where remote presentation of measured data such as machine position, water level, dial readings and other data is required.

The system can also be used in the reverse direction control mechanical movement remotely in any application where a

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Getting everything from one source means simplified specifying and buying. And getting it from Crane assures top quality in all materials for any piping installation.

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ONE SOURCE OF SUPPLY giving you the world's most complete selection of valves, fittings, pipe, accessories and fabricated piping—in brass, iron, and steel—for all power, process, and general service applications.

ONE RESPONSIBILITY for all piping materials—always helping you get the best installation, and avoiding needless delays on jobs.

ONE STANDARD OF QUALITY in every item—quality that keeps winning new friends for Crane—assuring uniform dependability and durability throughout piping systems.

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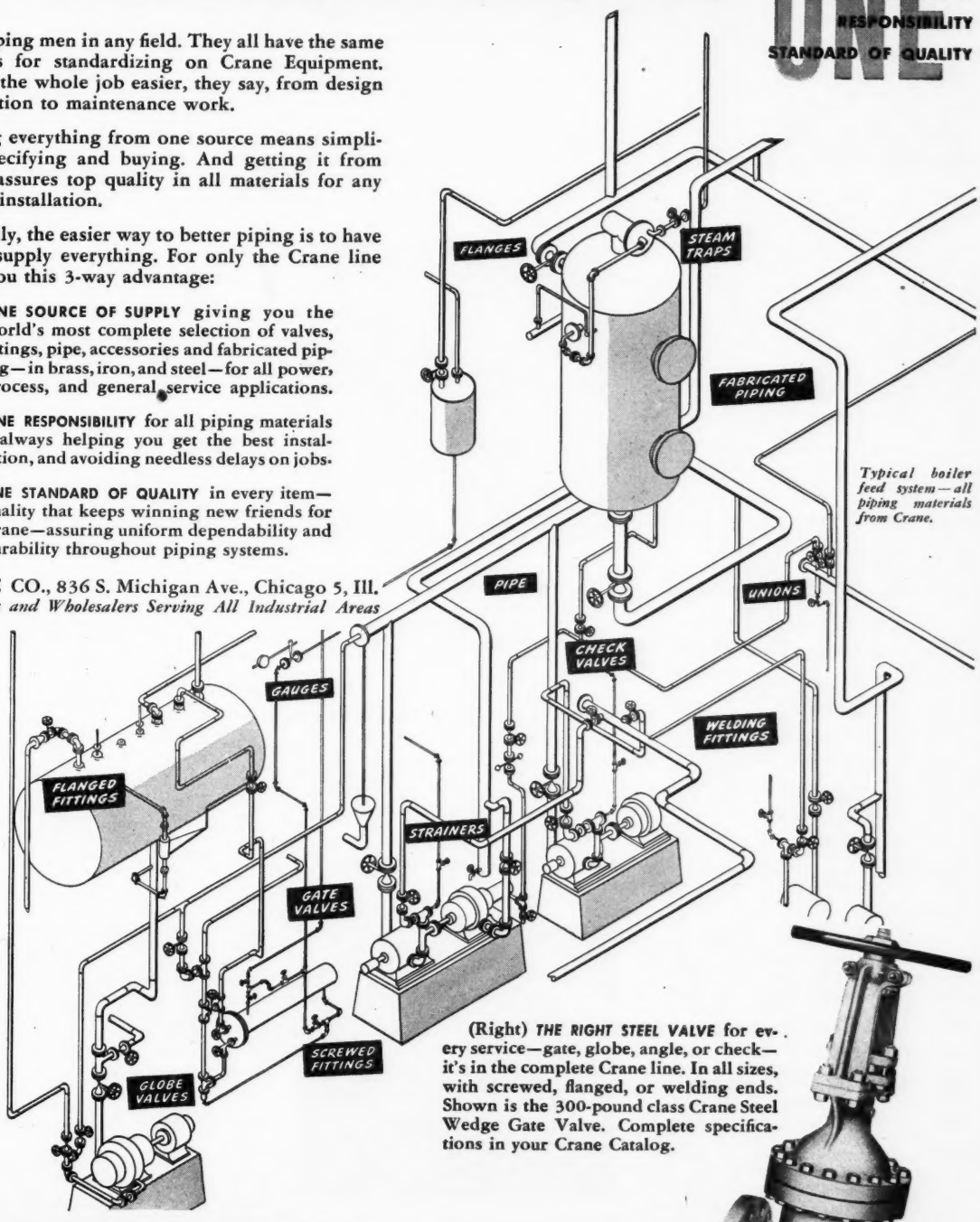

Typical boiler feed system—all piping materials from Crane.

(Right) ***THE RIGHT STEEL VALVE*** for every service—gate, globe, angle, or check—it's in the complete Crane line. In all sizes, with screwed, flanged, or welding ends. Shown is the 300-pound class Crane Steel Wedge Gate Valve. Complete specifications in your Crane Catalog.

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PIPE • PLUMBING
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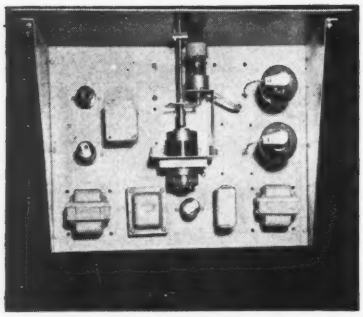
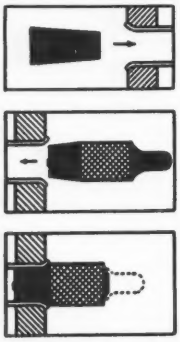
FOR EVERY PIPING SYSTEM



theoretical perfect long flexible shaft without backlash requiring inappreciable torque would be satisfactory. It also should be pointed out that the Follow-Up System serves as a torque amplifier. Since the control mechanism is essentially a shaft mounted in precision ball bearings without load, practically no power is required to drive the system. Quick heating tubes are used to minimize warm up time.

N Tube Tester Here is a recently announced tube tester (Detectaleak) designed by Condenser Service & Engineering Co., Inc. Through the use of this tester leaking tubes can be instantly located without dismantling the condenser. The tester consists of a rubber body, one end of which is conical to fit into the tube and the other end is a thin-walled



bulb. An air passage connects the bulb with the conical end. A knurled metal sleeve surrounds the body to provide a grip for the fingers .

The illustration shows how the tester works. With the condenser out of service, maintain vacuum in steam space with condenser steam jets; plug one end of tubes with fiber plus; insert Detectaleak Tube Testers in other end of tubes. If bulb is sucked tube in the tube leaks.

O New Paint Remover Bull Dog Remover, containing a newly formulated, quick-acting solvent for removing tough coats of old paint, varnish, enamel, shellac and lacquer, has been announced by Gilespie Varnish Co.

Supplied in liquid and cream form, Bull Dog Remover can be used equally as well on upright surfaces as on flat surfaces. It will stay moist and deep-cutting as long as 24 hours in the hottest sun, reducing hard finish coats to a quickly yielding sludge that can be readily stripped off without leaving a greasy film.

It is said to have no disagreeable odor; is free from acid and alkali reactions and is positively non-corrosive. It will not raise wood grain, damage the fibre, or injure the user or brush used to apply it.

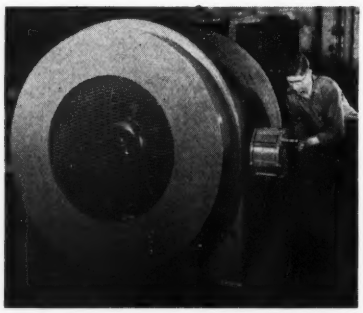
P Electrofluid Drive This new packaged power unit, called the "Electrofluid Drive," just announced by Link-Belt Co., is a neat compact motorized hydraulic combination consisting of a general purpose A-C induction motor, flange mounted on a sturdy housing containing a hydraulic coupling. Its output shaft may be direct-connected to the driven machine or to a speed reducer unit. It may also be connected to the driven machine through the medium of chain, gear or belt drives.

Each fluid coupling has a primary and a secondary element. The primary element may be likened to a centrifugal pump impeller and the secondary, or output element, to a water wheel or runner. The

coupling is filled with a light mineral oil. When the motor drives the impeller it causes oil to flow through the runner buckets back to the impeller thereby rotating the runner through the medium of oil. There is no mechanical connection between the two elements of the fluid coupling. It is available in sizes up to 20 hp.

Q Weatherproof Motors The Allis-Chalmers Mfg. Co. has announced that it is now producing a complete line of outdoor weatherproof, totally enclosed motors in the larger sizes ranging up to and above 2000 hp.

Principal change in the new line of motors in the larger ratings is a complete redesign of the ventilation heat-transfer system. All air passages are practically self cleaning and pockets in which water



or liquid might be trapped have been eliminated. Air passage tubes can be cleaned with a brush or an air or water hose.

The new totally enclosed all-fabricated steel motor is expected to find particular application in central station power plant service in connection with draft fans and in the chemical industry. Here, because of its water-proof joints and new cooling system, it promises to be as effective as cast iron motors.

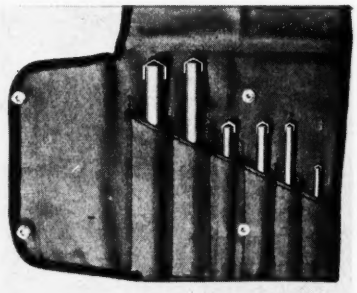
R Insulating Cambric In many insulating operations where varnished cambric is utilized, production can be accelerated and waste reduced by using varnished cambric with a gutta percha adhesive on the insluation. Gutta percha-backed varnished cambric—in tape form for coil wrapping, and in punched pieces—can be made to adhere to itself, metal, and other materials, it is announced by Irvington Varnish & Insulator Co.

When being applied, gutta percha-backed varnished cambric should be passed over a heated element keeping the varnished cambric side toward the heat. Above 150 F, the coating becomes a contact adhesive which when cooled forms a permanent bond impervious to moisture and affected only by intimate contact with organic solvents.

The gutta percha adhesive is applied on Irvington 0.003 in., 0.004 in, 0.005 in. varnished cambric, Style S.I.C. and 0.005 in, 0.007 in, and 0.010 in. varnished cambric.

S Masonry Drill Kit Wide-spread demand for its carbide tipped masonry drills—which drill holes in concrete, brick, tile, marble, slate, plastics, etc., four times faster and up to fifty times longer than drills made of the hardest steel—has enabled Carboloy Co., Inc., to drastically reduce prices on this particular line of tools. At the same time, the drills themselves have been improved and the most popular sizes have been made available in handy kit form.

The improved line of masonry drills

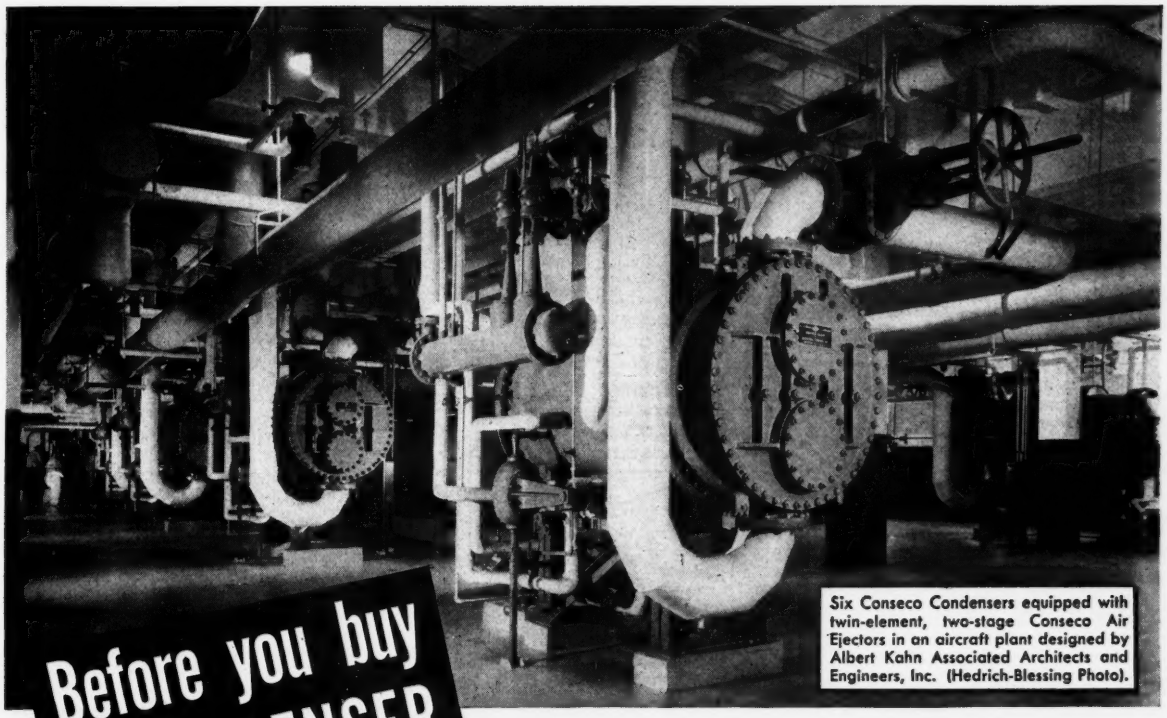


now includes 15 sizes, ranging from $3/16$ in. nominal diameter to $1\frac{1}{2}$ in. nominal diameter (sufficient over-size allowances are provided for proper hole size required for installation of such devices as expansion shields, anchors, and toggle bolts). Price on each drill size has been reduced some 40 per cent below previous levels, the $3/16$ in. and $1/4$ in. sizes now selling for $1.80 each compared with $3.00 formerly. Reductions range as high as $8.60 on the $1\frac{1}{2}$ in. size, which now lists at $12.90.

The drills come individually packaged, together with complete operating and service instructions.

The kit, illustrated complete with operating and service instructions, retails for only $13.70, the acutal price of the drills alone.

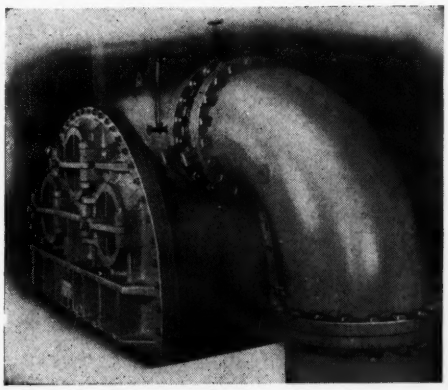
T Grinding Wheel Spectacular performance is claimed for a new "V-Eight" grinding wheel just announced by American Emery Wheel Works. The new wheel, said to be entirely different from any wheel now on the market, is similar in structure to the porous wheels which have been widely used in recent years but holds its corners even under



Six Conseco Condensers equipped with twin-element, two-stage Conseco Air Ejectors in an aircraft plant designed by Albert Kahn Associated Architects and Engineers, Inc. (Hedrich-Blessing Photo).

Before you buy a CONDENSER

Consult the men who built and serviced thousands of them



Conseco 9,000 sq. ft. condenser, showing easy-opening manifolds.

A CONSECO Condenser offers you advantages that go far beyond any performance guarantee. For years our maintenance organization has serviced, repaired, and rebuilt thousands of condensers of all types and makes for power, marine and industrial plants. This experience gives us a broad practical background for designing efficient, economical condensers for any requirement. Every detail in a CONSECO Condenser is designed to profit from good and bad features uncovered in the crucible of actual service.

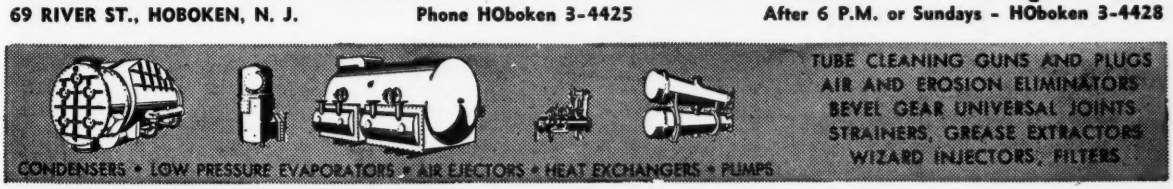
Our engineers will gladly work with you without obligation. And if you want fast action, name your own delivery date. Write, wire or phone us today.

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

SERVICE

CONDENSER SERVICE & ENGINEERING CO., INC.

69 RIVER ST., HOBOKEN, N. J. **Phone HOboken 3-4425** **After 6 P.M. or Sundays - HOboken 3-4428**


TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
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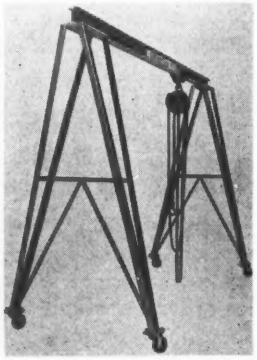
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS
CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

extremely heavy cuts and performs efficiently in dish and cup shapes. Its structure gives maximum air cooling for dry grinding and the open cells carry extra coolant when wet grinding. More metal is removed in less time and the wheel face is maintained with less dressing.

U New Type Gantry Crane Portability, ease in handling and flexibility for many varied lifting services are the features of this new gantry crane. Of 1-ton capacity with generous safety factor and minimum gantry weight, it has a broad variety of uses



at loading platforms and docks, in power plants, machine shops, factories and garages and for construction, maintenance and farms. Its price is $115.00 fob factory. It is made by Industrial Equipment Co.

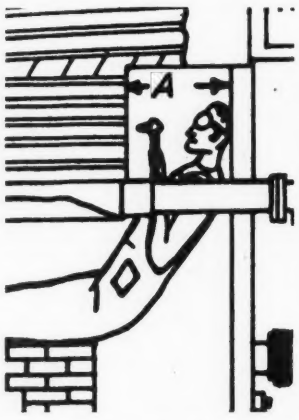
V New Steam Generator Union Irons Works has just announced a new "S" type steam generator. This boiler is compact; water wall unit does not require feeder tubes as the water wall headers are integral with the lower water drums to provide unrestricted flow of water to the furnace tubes. Top horizontal drum extends full length of seting being connected to two lower horizontal drums in the rear and to the water wall tubes in the front. Sizes up to 3000 sq ft of heating surface. Usually shop assembled, the "S" type is primarily designed for use with single retort underfeed or spreader stokers and oil or gas burners.

W Cutting Torch for Fire Tube Boiler Realizing a need to greatly facilitate repair of fire tube boilers, Air Reduction Sales Co. has made available a short cutting torch, with an over-all length of 13 in. This lever type torch can be furnished with either a 45-, 75- or 90-degree bronze head.

The new oxyacetylene cutting torch is particularly adaptable to the removal of worn tubes from the type of heating boilers found in office buildings, schools, large homes and factories where low pressure process steam is required.

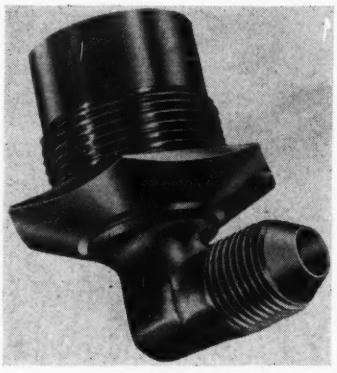
While easy access is gained to the front end of such boilers by opening the smoke box doors, space is usually limited at the rear. Airco's new 13-in. torch permits boiler repairmen to work efficiently in the confined work space, often as little as 12 in. deep.

When retubing, it is the practice of



skilled repair men to "wash off" the flanging or beading on the tube, and then make three or four gouges on the inner surface. If carefully done, the entire wall is cut without injury to the tube sheet and without cutting through the outside of the tube and depositing slags. Contraction after cooling then permits drawing the tube out through the front end of the boiler.

X Ball Bearing Swivel Pipe Coupling. All-Flex ball bearing swivel pipe coupling was specifically designed to solve one of the problems in the transmission of hydraulic power—that of conveying fluids under high pressure through a pipe which swivels or rotates a full 360 degrees. It is announced by Snyder Sales Corp.



This combination of multiple synthetic packings and metallic seals is described as offering protection against leakage at high and low pressures. A double row of ball bearings, plus metal-backed packings, gives low resistance to rotation, permitting ease of operation at all pressures.

Low torque performance is reported to be evidenced by tests of aircraft companies and Governmental agencies, showing a torque of 2.5 in. lb at 1500 psi and 9.6 in. lb at 3000 psi.

It is preferably made of steel, and is available in sizes from ⅛ in. to 1 in. nominal tube size with a variety of threaded and elbow connections to meet particular applications.

Y Industrial Oil Burner An entirely new development in the industrial heating field which will mean greatly increased heating efficiency was announced recently by the American Heat Corp.

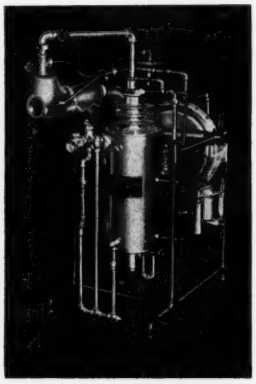
Called the Arc-Heat burner because it produces a completely white flame, the new burner operating in a commercial installation for more than a year produced savings of more than $550 a month.

Three outstanding features are claimed for the Arc-Heat burner. First is the development of a rarefaction chamber in which the oil, by head-on collision with air or steam, is transformed into a gas and in that form is sprayed into the fire box, thus developing almost complete combustion.

The second feature is the method of taking in free air. The Arc-Heat burner relies entirely upon induced air in the fire box and it draws in the air at speeds sufficient for proper combustion. No blowers or other forms of pressure apparatus are required to feed secondary air to the fire.

The third feature has been developed in the important field of modulation. The Arc-Heat burner has a modulating valve contained within itself which can restrict the amount of fire and therefore the amount of oil burned. One lever controls the modulating valve and the free air intake. Modulation can be so fine that it must be dialed by micrometer apparatus for annealing ovens and other equipment requiring precision adjustment.

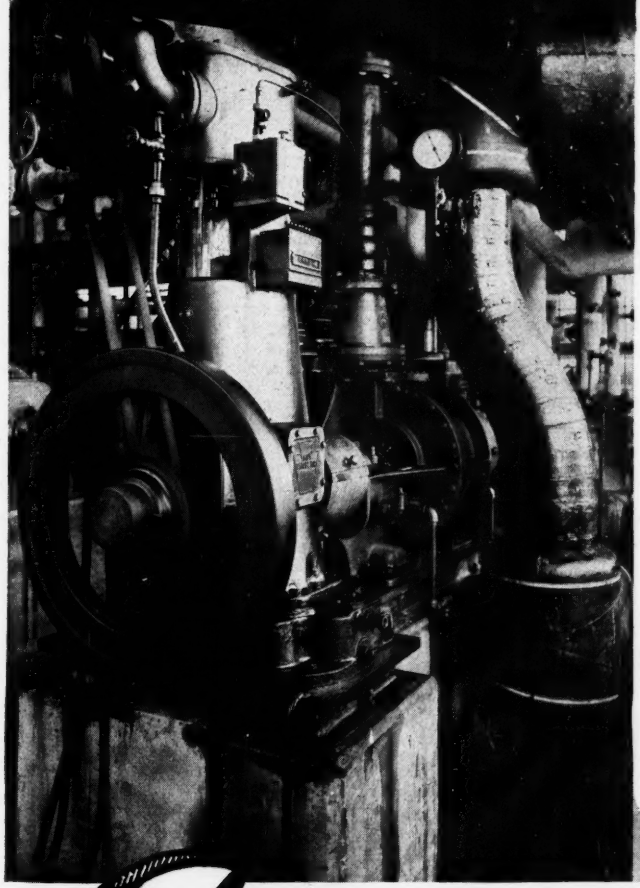
Z Oil Vaporizer A new oil vaporizer for industrial heat processing, standby equipment in case of gas failure or shut-off and pre-mixer for utility



gas is announced by the Vapofier Corp. Known as the Vapofier, this new equipment utilizes fuel oil, generates and supplies a vapor (vap-o-gas) which is then mixed with air and piped, burned and controlled in exactly the same manner as utility gas.

Operation is simple—fuel oil is maintained at a constant level in the combustion chamber by a simple valve float. The products of combustion are drawn through the surface of the oil in the combustion chamber, heating the oil to vaporizing

By-Product POWER drives this BLOWER



TROY—ENGBERG STEAM ENGINE

... AND BEING TROY ENGINE POWER IT IS EXCEPTIONALLY LOW COST POWER

Perhaps you aren't familiar with what we call "By-Product" Power. It's power that is extracted from steam drawn from the boiler plant for use in processing or in a heating system.

The Troy-Engberg Steam Engine is industry's unit for this purpose. It is ideal for driving pumps, compressors, blowers, fans, generators, cookers and other equipment that calls for conservative speed. It passes on in the exhaust approximately 90% of the heat units originally in the live steam. Case studies show that this power after a few months or a year or two costs practically nothing.

We suggest you look fully into the advantages to be gained by driving your equipment with Troy Engines.

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TROY-ENGBERG

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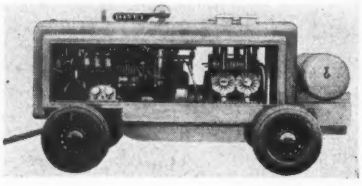
temperature. The vapor thus created is drawn off through the pre-mixer where proper fuel-air ratio is established and maintained. The combustible mixture is then piped to the burners. Fuel-air ratio may be predetermined and maintained throughout the entire range of capacity. Flame quality may be widely varied from oxidizing to reducing.

The Vapofier is available in eight standard sizes with capacities from 70,000 btu per hr or 0.5 gal per hr to 2,000,000 btu per hr or 14 gal per hr and occupies only 2 by 4 ft of floor or overhead space. Larger sizes can be built on special order to meet requirements.

AA V-Belts Added to Line In another one of its progressive steps, Quaker Rubber Corp. has just added industrial V-belts to its line of rubber products.

Quaker reports that these belts will have five special features: 1. Flexibility. 2. Heat resistance. 3. Abrasion resistance. 4. Balance. 5. Made with all new equipment.

BB Air Compressor Production of the first model in the 1947 Davely line was announced recently by Davey Compressor Co. Known as the "315-W" (gas) and 315 WD (Diesel), the new machine produces 315 cu ft of free air per minute at 100 lb pressure. It is available in standard skid, steel wheel trailer, and pneumatic-tired trailer mounting styles, and flanged wheel types for railroad



work. On trailers, spring-mounting is included without extra cost.

The compressor unit represents a radically new departure in Daven design. It consists of two banks of three cylinders, each bank being arranged in W form. This construction, together with a short 4 in. piston stroke, reduces compressor vibration to an absolute minimum and results in a cooler-operating, more efficient machine.

The W design also permits of substantial reductions in dimensions and weight. Gasoline-driven units have an over-all length of 140 in. while Diesel machines are 12 in. longer. Height is 72 in. and width 65 in. for both gas and Diesel machines. Gas units weigh 7,400 lb and the Diesel weight is 7,800 lb.

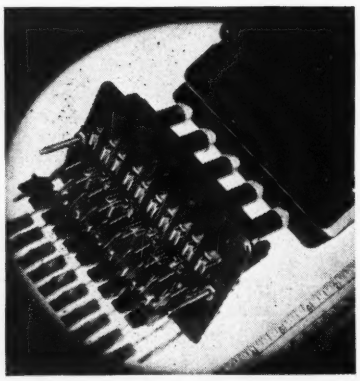
Standard gas units are currently equipped with Hercules RXLD engines, and Diesels employ International UD-18 power plants. Other makes of engines will be made optional as the engine production situation improves. Electric starters are standard on Diesel machines.

CC Electric Blower An improvement in the design of electric blowers, for blowing out dust and lint from motors, machinery, etc., is announced by the Breuer Electric Mfg. Co.

Basic features of design of this new and improved model, known as No. 46, are said to include: Balanced fan design, with solid, full-diameter back, provides greater air displacement and adds strength and durability. Screened openings, placed at strategic points around the sides of the motor housing, permit concentration of air over the commutator and brushes, providing a more effective and larger volume of cooling air where most needed. Size of openings conforms to government specifications. Improved switch, installed at end of handle, gives better balance and provides easier operation. Toggle switch is located for easy thumb operation.

Unit is equipped with a ⅓ hp G.E. universal motor, with sealed ball bearings that require no subsequent lubrication.

DD Switchboard Device Testing The Flexitest, a new test switch for rapid, accurate testing of switchboard instruments, meters and relays from the front of the board is announced by Westinghouse Electric Corp.



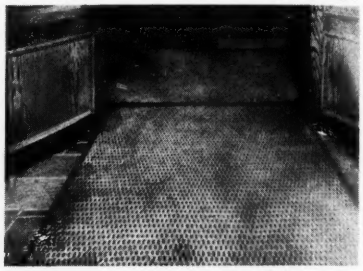
Designed with up to 10 elements and rated at 250 v, 30 amp, combinations of current and potential switches are included as required for various types of instruments to be tested.

Safety and accuracy are increased by constructing the switch so that a plug properly connected to the test instruments can be used to check from the front of the board in rapid succession all meters or instruments of a particular type.

The Flexitest switch is enclosed in a black Moldarta case with cover of similar material that blends well with instrument and relay cases and with panels. It is compact and mounted semi-flush on steel panels of any of the usual thicknesses. The width is such that it can be mounted on the same centerlines as standard instruments and relays.

Individual switches are of the knife blade type and separated by barriers. Moldarta switch handles are recessed for inserting identification cards. Each switch handle is drilled for insertion of an interlocking bar to tie together any three adjacent handles. The right hand switch, when used for a strip circuit, is provided with a red handle for easy identification. Means are provided for attached spring clips when individual test leads are used instead of a test plug.

EE Floor Matting American Mat Corp. announces the manufacture of a new tire fabric matting known as Tuf-Tred. This matting is constructed of corrugated tire fabric links, strongly



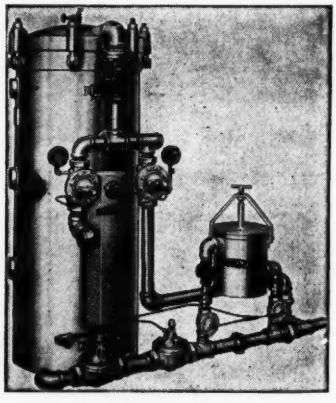
laced on galvanized rust-resisting steel wires. No metal is exposed to cause a cutting or tripping hazard.

The mat has long wearing qualities, is economical, a good dirt remover, prevents slipping, affords comfort and is quiet and resilient in use. It is approximately 5/8 in. thick, comes in widths up to 6 ft in any length and weighs approximately 2½ lb per sq ft.

FF Water Filters A new series of water filters for swimming pools and industrial water filtration is in production at Bowser, Inc., it has just been announced. Known as the Fig. 611 Series, these filters range in capacity from 15 to 500 gpm with 7 to 248 sq ft of filtering area to serve all sizes of swimming pools and most industrial requirements.

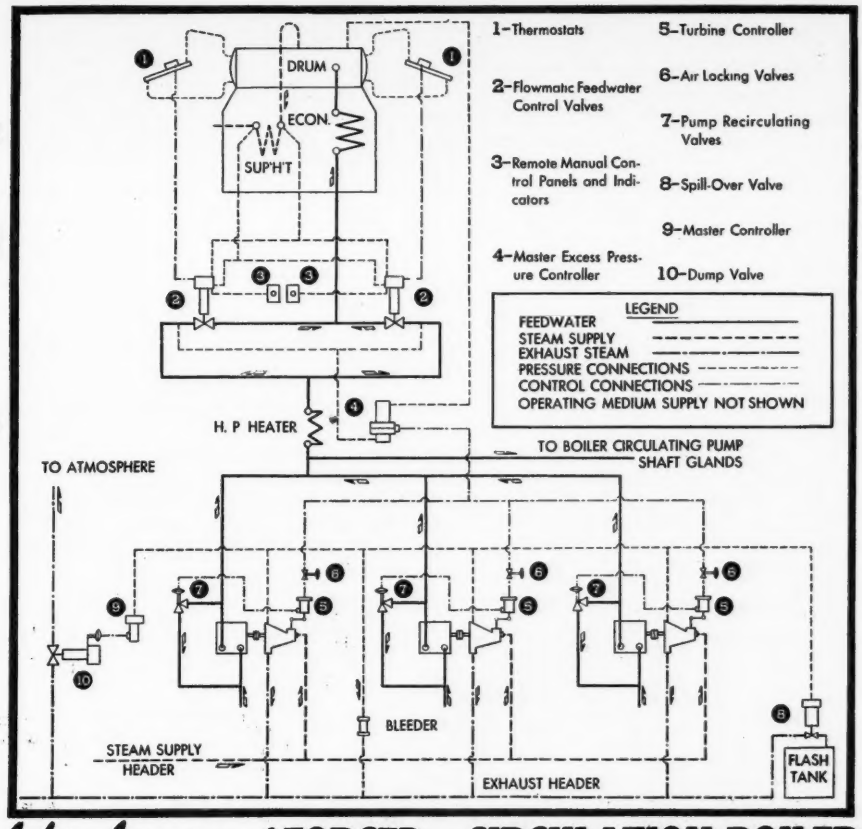
It is said that these filters occupy only 1/20th the space needed for conventional sand filters. Filtered impurities are periodically backwashed to waste to improve sanitary conditions and no manual cleaning operations are required.

Filter elements are tubular, plastic impregnated cartridges which support the filtering medium. Diatomaceous earth is deposited evenly on these cartridges from the pre-coat pot and removes particles as small as ½ micron (approx. .00002 in), including all dirt, oils and other foreign matter.



Here is the

COPES
FEED WATER CONTROL SYSTEM



for the worlds largest FORCED - CIRCULATION BOILER

IN cooperation with plant engineers and consultants, COPES engineers developed this feed water control system for the world's largest forced-circulation boiler. Maximum continuous rating is 650,000 pounds per hour, with 1825 psi and 960 F at the superheater outlet. Excess water pressure is maintained constant by COPES Master Control. Boiler water level is held within close limits by two-element COPES Flowmatic Control. For a complete description of this installation - - - with charts showing performance on constant and regulating loads, and under emergency conditions - - - write, your letterhead please, for Bulletin 447.

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1262 GROVE DRIVE
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Feed Water Regulators, Pump Governors, Differential Valves.
Liquid Level Controls, Reducing Valves and Desuperheaters.

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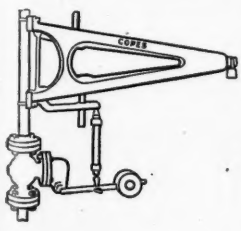
★GET CLOSER LEVEL CONTROL WITH COPES FLOWMATIC

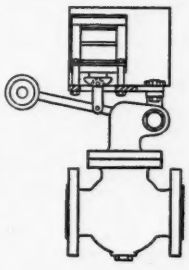


FOR SMALL BOILERS

If you have smaller boilers which carry reasonably constant loads at moderate pressures, you can get all the benefits of continuous feed and stabilized water level from COPES Type OT - - a simple level control feed water regulator. Compact, it is easy to install and maintain. A proved performer in hundreds of plants. Write for information.

SOLENOID VALVES

There must be a good reason why important plants have gladly paid a premium for COPES Solenoid Valves. It lies in the sound engineering design, plus the rugged construction which stands up under use and abuse. Not a stock proposition, each valve is tailored to the needs of the individual installation. Sizes: ¾ to 6 inch. Information on request.



EXPANSION JOINT MAINTENANCE

65¢ PER YEAR!

Here's a maintenance record on Yarway Gun-Pakt Expansion Joints that is hard to beat. It was made by a large Southern utility. Over a period of 14 years they purchased 66 Yarway Gun-Pakt Joints. During that time the only maintenance items, aside from labor, have been 42 gals. of lubricating oil and 80 lbs. of special Yarway packing, costing a total of $344.00. Averaged against the service period of each Yarway joint this material maintenance cost comes to $5.40—*or just 65 cents per year per joint!*

No wonder so many utilities, industrial plants, institutions and public works insist on Yarway Gun-Pakt Expansion Joints — called by many the "greatest expansion joint improvement of modern times."

For full information on these modern expansion joints that can be serviced under full steam pressure, write for Bulletin EJ-1911.

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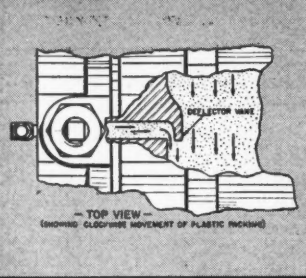
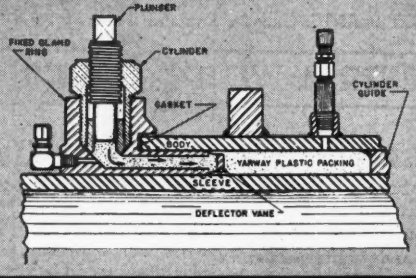
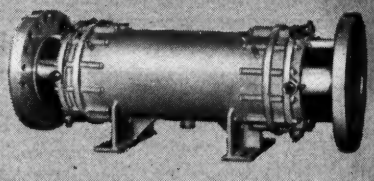
SEE YARWAY EXPANSION JOINTS along with other famous Yarway steam plant equipment in the new 30-minute color and sound motion picture "There Is An Engineering Reason." Hear Lowell Thomas describe their application. Free for group showings. Write for details.

Maintenance man servicing a typical Yarway Gun-Pakt Joint







Double end flanged-type Yarway All-Steel Gun-Pakt Joint, 300 lbs. pressure.

YARWAY GUN-PAKT EXPANSION JOINT

WHAT LEADERS SAY

Engineers in Public Life

By CARL HINSHAW

ENGINEERS and other professional men in government service, from the municipal to the federal levels, sometimes make disparaging remarks concerning the elective officials under whom they serve. It is true that there are too many examples of ignorant but successful politicians in public office. But I am wholly out of sympathy with the type of remark I have mentioned.

Whenever I hear such a remark my first question is, "Why don't you run for public office? The people need men of your talents and abilities as city councilmen, county officers, state legislators or Congressmen—or whatever the office. You have no right to complain of that one's shortcomings unless and until you yourself have either submitted yourself to the choice of the people, or have done your utmost to see to it that another good man consented to run and was elected. Politics is just what good citizens permit it to be. Merely casting your ballot is not enough to square you with your duty as a citizen. Citizenship is a precious privilege that you must work at to deserve. If an ignorant or a bad man achieves public office do not blame him—blame yourself. He only seized an opportunity that you let pass. If an intelligent and good man achieves public office it is your duty to support him against all detractors and defamers."

Engineers make splendid executives in government, but rarely are they found in positions of highest authority. Those positions are most frequently held by lawyers. Why is that so? I think it is because lawyers are trained in public speaking and in thinking while speaking. They become resourceful proponents and opponents in debate. In addition to their basic training in the law they must achieve a widely diversified knowledge, even though it may only be a smattering of knowledge, in many other fields. The engineer on the other hand generally confines himself to intensive specialization in his chosen branch of engineering. He can be very interesting to a receptive audience in his own domain, but he is generally tonguetied in public.

Many times I have pondered the reason why so few engineers offer themselves as officers of our local, state, and federal governments. The pat answer is that perhaps they are too smart to get caught up in the maelstrom of politics, but we must reject that answer because at best it could be only an excuse.

Politics is indeed a churning maelstrom from which one may be dashed against the rocks of misfortune or drowned in oblivion. To be successful, one must be able to take the buffetings as they come and steer a steady course. Politics is far from being an exact science, and in many aspects it is not even logical. The logical, precise mind of an engineer is likely to shrink from politics as unworthy of his talents. That is where the engineer makes a great mistake. In avoiding politics he is depriving his community, his state, and his country of a type of leadership that is sorely needed.

The engineer is reared in the cloistered precincts of a drafting room or laboratory where hangs the admonition, "Silence—brains at work." He learns to express himself in the terse language of a written report—in precise figures and in neatly drawn lines. His imagination, his genius, is expressed in calculations made with infinite care, which flower on a drafting board, and bear fruit in the form of amazing structures.

When an important public project is completed, a big dedication ceremony is held. The governor, the mayor, the board of public works, and prominent citizens of other degrees gather, and the wind instruments of a brass band cause the bunting and the banners to stream out proudly. A fine bronze plate is then unveiled to an astonished multitude proclaiming the names of the public officials under whose regimes the project was nurtured into reality. In relatively small type the plaque may perhaps mention the name of the chief engineer of the Board of Public Works.

Some of the engineers who stewed and sweated and refigured and redrew the plans for the project which was their brain child, may be found standing modestly in the background, wistfully enjoying the evidence of public pride.

But is the conception, design, and execution of projects the limit of his mission in life? I say no. If he limits himself to those things, the engineer is merely a servant of others in authority. To achieve his highest usefulness to our society, the engineer should himself achieve authority in the affairs of society. His highly trained hand, his resourceful mind, and his inherent integrity are needed in positions of authority, to direct the collective efforts of society—to avoid waste, to advance the most useful ideas, to quash the rash and hare-brained ideas, to sway public opinion toward good works, to "run interference" for the advancement of the welfare of society.

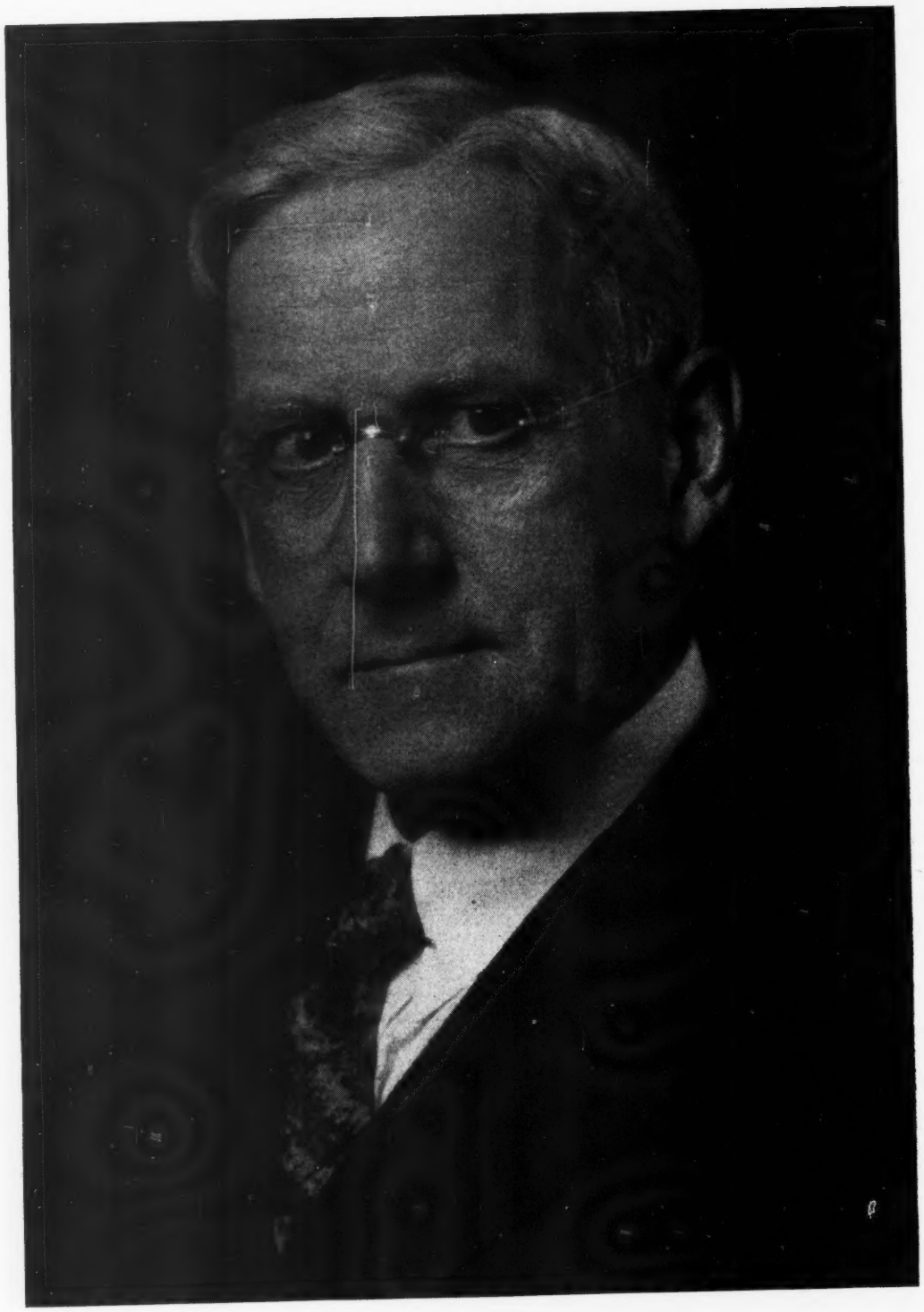
What is the right road to a solution? Does it start in school and college? Of course it can. But instead of joining a debating society largely frequented by adolescent lawyers and preachers, who naturally choose purely political or ethical subjects for debate, the student engineer should join or create a debating society to engage in heated discussions on questions where his training will support his thesis. Question: "Should the New Jersey Barge Canal be built?" Question: "Should railroads be permitted to own and operate airlines?" Question: "Should the commerce of the highways be taxed for highway construction, or should the tax be upon the abutting property owners?"

There are thousands of such questions that should be debated by young and budding engineers. Each part of our country has important questions to decide that can be presented expertly by engineers. Let them learn to speak, and to speak out the truths they learn and know instead of modestly waiting to be consulted. People need to know such basic truths to guide them in their political expressions.

In a technological civilization, why is it that our laws are made primarily by lawyers and not by men wth engineering and business background whose work so powerfully affects that civilization? Carl Hinshaw, one of the very few members of the Congress possessing such a background, indicates the answer to that question and points out that the engineer ought to make his influence felt more powerfully in our public life. He is in a position to speak with authority on this subject, for he has been elected three times to represent the Twentieth District of California in the Congress of the United States.

Born in Chicago in 1894, he attended public schools there; went to Valparaiso University (Indiana); was graduated as a civil engineer at Princeton University in 1916, then took post-graduate work in business administration at University of Michigan until 1917, when he enlisted in the U. S. Army. From that he emerged in 1919 as Captain, Corps of Engineers.

Returning to Chicago, he entered automotive manufacturing and sales, progressing to various managerial capacities until 1927; then entered the investment banking field in the reorganization and consolidation of industries. In 1929 he moved to Pasadena, Calif., where he entered the real estate and insurance business, became active in civic and political affairs and was elected to represent his district in the 77th, 78th and 79th Congresses. The above comments are extracted from an address before the ASCE (of which Mr. Hinshaw is an Associate Member) at Philadelphia earlier this year and are reproduced from CIVIL ENGINEERING.



Arthur Louis Rice
May 14, 1870—November 10, 1946

ARTHUR LOUIS RICE

IN THE PASSING of Arthur Louis Rice on November 10, the engineering profession has lost one of the builders of power plant engineering as it is practiced in America today. Early in his professional life he developed a liking for educational work and from the days of the early 1890's his teaching instinct was prominent throughout the long years of his busy life, first as a college instructor, later in the activities of engineering societies, as a writer of engineering literature published in magazine and book form, then as editor and lastly as editorial director of *Power Plant Engineering*.

Seeking always the wide distribution of engineering information among those who could use it to greatest advantage, he spent much of his valuable time helping engineers find the solutions to their bothersome problems. For years on the contributing staff of the American School of Correspondence, he prepared portions of their books dealing with power and allied topics. He also served on the Advisory Board of La Salle Extension University.

Having been graduated from Worcester Polytechnic Institute with the degree of B.S. in M.E. in 1891, and B.S. in E.E. in 1893, he extended his formal education at Cornell University where he received his M.M.E. degree in 1896 and was elected to membership in the honorary fraternity Sigma Xi. While carrying on his graduate work he was instructor in steam engineering at Worcester and later at Cornell, and for the six years from 1896 to 1902 was in charge of the Department of Applied Electricity at Pratt Institute. During the year 1902-03 he was Assistant Secretary of the A.S.M.E., which position he left to become Editor of "The Engineer" from 1903 to 1908. Technical Publishing Co. was then formed to purchase and publish the *Practical Engineer* the name of which was changed to *Power Plant Engineering* in 1917.

His duties in this new organization were editor and treasurer. The fiftieth anniversary of this publication, by coincidence, is being brought to the attention of readers in this issue. Throughout the entire life of this Company Mr. Rice has been the guiding spirit of the editorial and business policies of the organization and, except for the past few years when failing health interfered, was continuously engaged in Company activities.

Thus Arthur Rice, the educator, fitted his talents naturally into the publishing business where he could reach thousands of engineers each month with information on advanced engineering practice, and through editorials, lectures, correspondence and personal interviews give direction to the thinking of those in the power plant engineering field. Then, too, as an employer, he was regarded as an instructor whose directives were constantly building the employee for self improvement and advancement in responsibility.

His talents were recognized by many outside the engineering and publishing field and he gave unstintingly of his time to such character-building activities as the Boy Scouts of America in which organization he founded one of the first troops and served for several years as Scout Master. Service on the Board of Education of Wilmette, Ill., his home city, claimed considerable of his time as did the Wilmette Public Library.

During World War I, Mr. Rice was instrumental in organizing a Home Guard Unit and served as an officer in that unit.

Arthur Louis Rice was born May 14, 1870, at Barre, Mass., the son of Henry E. and Elisabeth F. (Rawson) Rice. He was married to Miss Anne E. Cook of Barre, Mass., June 29, 1893. Children of this union are Kingsley L., Elisabeth B. (Mrs. Armand J. Gariepy), and Arthur L. Rice, Jr. Mrs. Rice died in 1922 and Mr. Rice married Miss Madge Waters of Sarasota, Fla., on January 21, 1928, to whom a son, Reginald W. Rice, was born. All of his children survive him. Kingsley L. Rice is president of Technical Publishing Co., a position he has held since 1938, and Arthur L. Rice, Jr., is advertising sales representative of *Power Plant Engineering* in the Chicago territory.

His interest in the advancement of engineering prompted Mr. Rice early in his career to associate himself with a number of the prominent engineering societies and associations. In 1895 he joined the American Society of Mechanical Engineers, served on many of its committees, both local and national, and was the Society's Vice President in 1922. At the annual meeting of the Society a year ago he was presented a fifty-year membership certificate. He was a member of the Western Society of Engineers and an honorary member of the National Association of Practical Refrigerating Engineers, also of the National Association of Power Engineers. In 1924, at London, England, and again in 1930, at Berlin, Germany, he was delegate to the World Power Conference representing the A.S.M.E. through the American Engineering Council, being vice president of the educational division in 1930.

Arthur L. Rice—the engineer, educator, journalist, publisher, patriot, character builder, employer—has lighted the torch of learning for thousands of men to carry on their journeys. We in the organization which he developed are sad at the parting but extremely proud of the association we have had with this grand man who was the personification of modern culture.

Power Plant Fire Protection

Transformer station is one of an industry's major fire hazards—Carbon dioxide is recognized as an effective fire-fighting agent when dealing with electrical equipment—Fire extinguishing equipment for transformer vault in Brooklyn is described—Operation of system outlined

By P. W. EBERHARDT Vice President, Walter Kidde & Co., Inc.

IN A LARGE industrial plant, where all electric current is brought in from outside sources and stepped down to conform to the plant's needs, one of the major fire hazards is the transformer room or vault which contains one or more of these electrical units. Here, in one confined location is the source of an industrial plant's power, whose destruction or damage can paralyze the operation of hundreds or even thousands of industrial machines.

Since large transformers usually contain quantities of highly flammable oil, the fires which start in these vaults combine the worst features of both electrical and flammable liquid fires. For that reason, the extinguishing agent used in quenching the fire must be a non-conductor of electricity as well as a smothering agent. The National Fire Protection Association recommends that carbon dioxide be used in such cases since it readily conforms to both requirements. In its action, carbon dioxide reduces the oxygen content of the air from 21 per cent to 14/16 per cent which is sufficient to "starve" the flames and kill the fire. Since it is also an inert gas, carbon dioxide is harmless to humans and finest equipment is unaffected by its action.

A typical, modern installation of a carbon dioxide fire extinguishing equipment for transformer vault protection can be found in the 27th Street Shipyards of the Bethlehem Shipbuilding Corp. in Brooklyn, N.Y. This vault, L-shaped to provide complete separation of the transformers and switch panels, contains ten transformers separated into banks of three, three, and four. The two banks of three transformers each are located on the sides of the vault while the center bank contains four. The three largest transformers are single phase, oil insulated, self-cooled 500 kva units with a stepdown range of 4400 to 2200 v. The next three largest are single phase 200 kva units with a stepdown range from 2300 to 440 v while the center bank of four contains one 200 kva unit and three 50 kva units with a stepdown range from 4160 to 110 or 220 v. All power comes from the utility company on a 4150-v line.

The carbon dioxide system works automatically. To accomplish this,

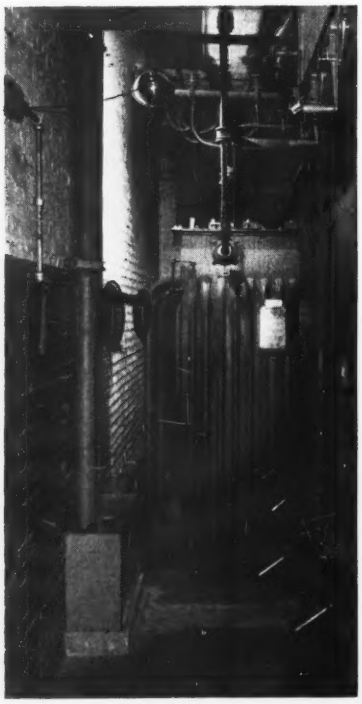


Fig. 1. Above. The line of shielded nozzles which directs the fire-killing carbon dioxide around the transformers and switch panels is shown at the left of the picture. (Color spots indicate location). The flaring of the nozzles provides the widest possible diffusion of the carbon dioxide in the shortest possible time

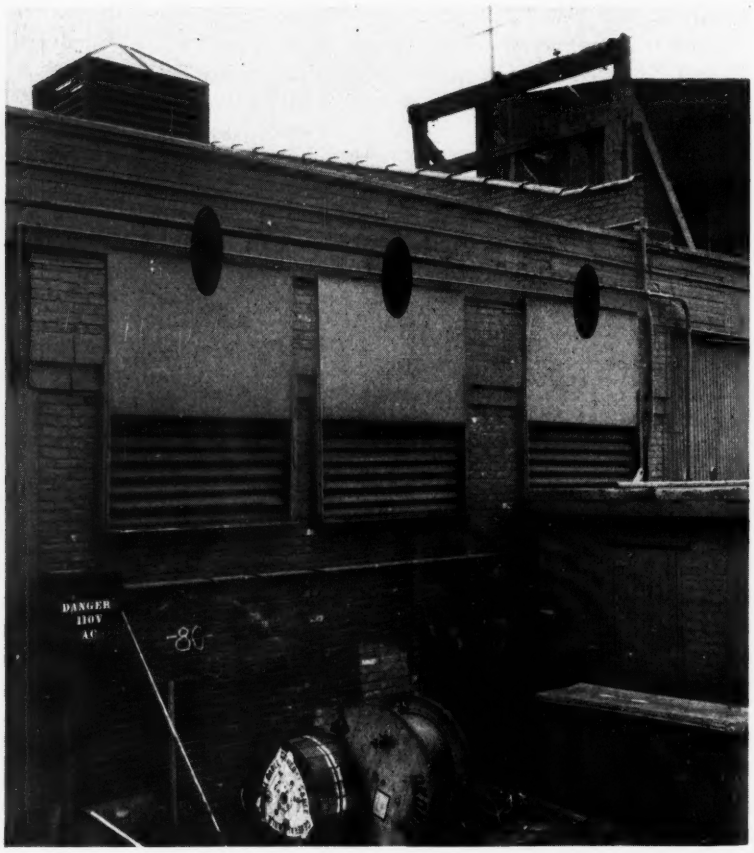
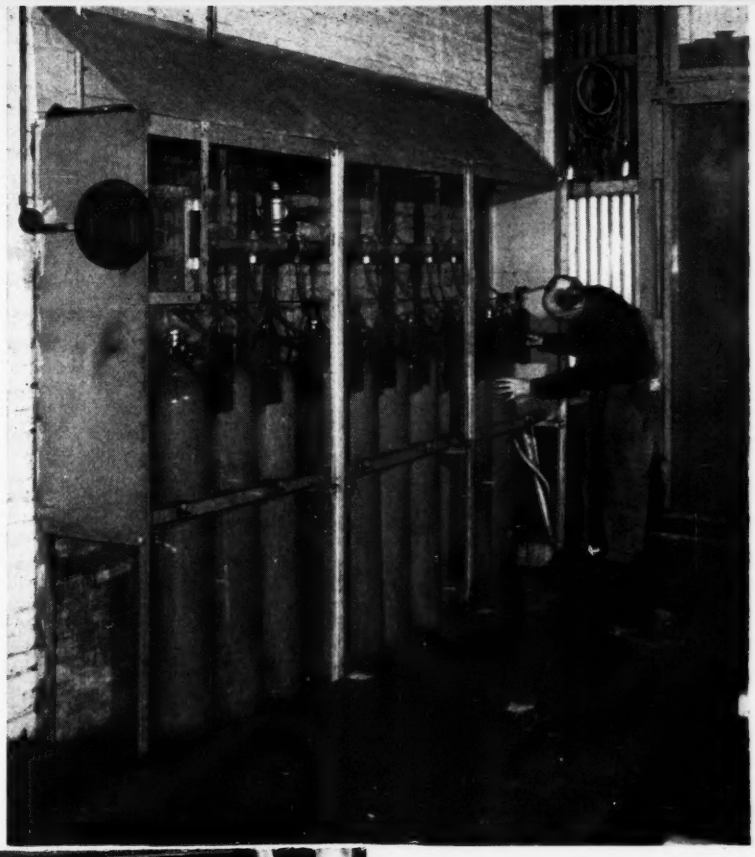


Fig. 2. Right. Another method of insuring air-tightness of a transformer vault would be the use of heavy steel panels suspended over windows. The carbon dioxide activates pressure trips which drop these panels over the windows allowing the carbon dioxide to kill the flames without interference from stray oxygen

three heat actuators have been placed in strategic spots located in the ceiling of the vault. When fire breaks out, and fire-heated air rises to the ceiling, air within the actuator expands. A wave of pressure passes through the tubing to the release mechanism located on the outside of the vault. Here the mechanism is connected to a bank of ten 50-lb cylinders of carbon dioxide, stored as a liquid under pressure of 850 psi. As the release mechanism goes into action, heavy weights fall and open the proper valves, thus allowing the carbon dioxide to rush from the cylinders through the piping and out the nozzles directed at the hazards. As the carbon dioxide leaves the nozzles it expands, in gaseous form, to 450 times its stored volume, rapidly reducing the fire's oxygen supply and quenching the fire. As a supplement to the automatic release device, two manual control devices, which will also release the gas, are located on either side of the vault.

The initial rush of carbon dioxide from the cylinders is also released through screening nozzles inside and beneath the three louvered windows. These screening nozzles throw a protective wall of carbon dioxide across the windows as an air block. This insures air tightness of the vault allowing the carbon dioxide to work in a closed atmosphere, thus permitting total flooding of the area with carbon dioxide.



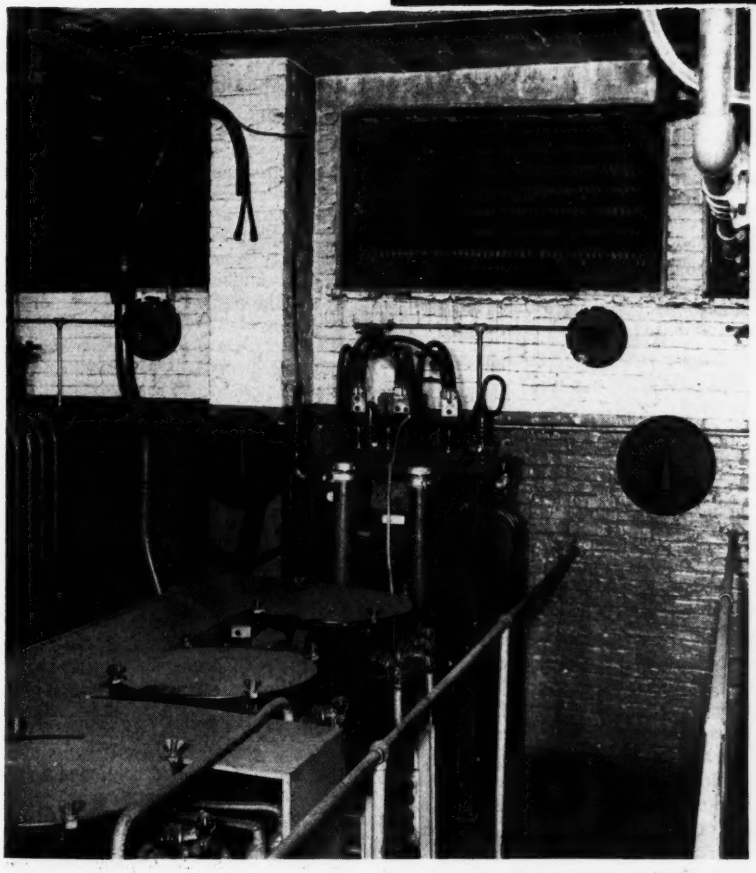


Fig. 4 Above. The ten 50-lb cylinders of carbon dioxide are stored outside the transformer vault where they may be easily inspected and checked. The carbon dioxide is stored in liquid form under 850 psi pressure, and when released expands in gaseous form to 450 times its stored volume. One of the manual release controls is shown, circled in color, at the end of the cylinder bank. This control is a compact unit sealed in glass with a small metal hammer hung on the side of the control to use in breaking the glass whenever necessary. The carbon dioxide can be released by a pull on the readily-gripped handle. The release is painted red to insure prompt recognition in case of emergency.

Fig. 3. Left. The screening nozzles in color circled with dotted line, discharge the carbon dioxide across the louvered windows, acting as a block to prevent stray oxygen from entering the vault. The shielded nozzles below, in color circled with solid line, direct carbon dioxide down and around the transformers where the expansion of the gas carries it into every nook and cranny of the vault. This effectively quenches the fire in a matter of seconds

Dangerous Electric Currents

Effect of electric shock upon living animals . . . Current, not voltage determines the effect of the electric shock upon living bodies . . . Ventricular Fibrillation . . . "Let-go" Currents . . . Effect of condenser discharges and Studies regarding the hazards due to impulse voltages . . .

By CHARLES F. DALZIEL Associate Professor, Division of Electrical Engineering, Univ. of California

PROGRESS in the development of electrical equipment has brought increasing demands for additional knowledge on the effects of electric shock, particularly with regard to the maximum current that man might be reasonably expected to withstand without fatal results. Sensations, muscular contractions, and the current required to cause the victim to "freeze" to a circuit have been fairly well covered in recent papers on "let-go" currents.[1,2,3] The object of this article is to extend the analyses and discuss effects at higher currents.

Any definition of lethal currents must consider the following factors: (1) Current pathway through the body, (2) physical condition of the victim, (3) magnitude of the current, (4) shock duration, (5) frequency, (6) wave form, and (7) the phase of the heart-cycle at the instant the shock occurs.

Effects of Electric Shocks

Electric shocks produce different effects depending upon the structure through which the current passes. Currents flowing in the region of the heart may produce a condition of the heart muscle known as ventricular fibrillation. This condition is usually fatal and is commonly referred to as instantaneous electrocution. Currents passing through nerve centers controlling breathing may produce respiratory inhibition, that is, stoppage of respiration. Failure of the breathing mechanism is often temporary, the paralysis lasting from a few minutes to a few hours after interruption of the current. These victims may often be saved by prompt application of artificial respiration. Currents passed across the head from temple to temple may produce unconsciousness and muscular convulsions. Shocks of this type are currently used in electric shock treatment in certain types of insanity. If the current pathway involves lower nerve centers, the shock might produce ejaculation. Electric ejaculation and artificial insemination apparently have promise in breeding animals. If the pathway involves only an extremity, such as a hand or leg, memory of a disagreeable experience might be the only lasting result. Because of such variations in the effects of electric shock, it is customary to discuss lethal currents with respect to the most dangerous current pathway likely to be experienced in accidents. This is a pathway involving the heart, with external contacts usually assumed between the hands, or between one hand and the opposite foot.

Much attention has been given the study of fatal accidents. These studies have been very helpful in developing practical safety procedures and safety codes. From a technical point of view, results have been qualitative rather than quantitative. This is largely due to the difficulty of determining accurately the many variables involved. In addition to the factors already mentioned, it is usually possible only to make rough estimates in arriving at values of circuit impedance, body and contact resistances, and elapsed time between occurrence of the accident, rescue, and resuscitation.

Current Not Voltage Determines Shock Intensity

Often these uncertainties have resulted in erroneous conclusions, and have confused the issue. Perhaps the most serious misconception concerns the effects of voltage versus the effects of current. Current and *not* voltage is the proper criterion of shock intensity. The remainder of this paper will be devoted to a discussion of the electric shock hazards due to currents of various shock durations, wave shapes and frequencies.

Sixty cycle currents at the "let-go" level, that is, currents of 10 to 20 ma from hand to hand, are painful and hard to endure for even a short time. If long continued, they may lead to collapse, unconsciousness, and death. The physical condition of the victim is of prime importance in determining this hazard. The muscular contractions and accompanying sensations increase in severity as the current is increased. The muscular contractions progress up the arm to the chest until they become so severe that the victim is unable to breathe. Obviously, if the current flows for more than a few minutes, death may result from asphyxiation. However, if the circuit is interrupted in a reasonable time, breathing resumes automatically, and no serious after-effects result. Currents considerably in excess of those required to cause a stoppage of breathing due to excessive muscular contraction of the chest muscles may produce a temporary paralysis of respiration due to action on the nerves. It has been known for some time that respiration might be inhibited by currents passing through the respiratory nerve center located in the base of the brain. Observation of temporary muscular paralysis in human accidents has prompted Howard Miller, Southern California Edison Co., to suggest that respiratory inhibition might also be caused by currents affecting the nerve centers controlling the diaphragm. The suggestion is in agreement with W. Einthoven, who some 30 yrs ago, demonstrated that electric currents applied directly to a nerve, insufficient to cause permanent damage, could produce complete blocking of the nerve for the periods of the order of one-half hour. The respiratory paralysis may last for a considerable period after interruption of the current. In this case, resuscitation must be applied immediately to prevent asphyxial death. Often the paralysis disappears in a few minutes, or in a few hours, and continued application of artificial respiration may save the victim. Mere cessation of natural breathing is not likely to produce serious after-effects or permanent damage,

1,2,3. For all numbered references see list at end of paper.

In view of the vast amount of electrical literature in the world today it is curious that comparatively little attention has been given to the effect of electric currents upon living animals. Only within recent years has there been any serious study of such effects. Among those who have given considerable attention to this subject is the author of this paper. He has presented a number of papers on the subject and in these papers he has disclosed facts concerning electric shock that should be of interest to every person whose daily work exposes him to the danger of electric shock. The article presented here is an abstract of a paper he delivered at the A.I.E.E. Summer Convention in Detroit this year and to a large extent it summarizes what is known about the effects of electric shock at the present time. The original paper contains a considerable amount of mathematical analysis which it was not feasible to present here but even without this, Mr. Dalziel's discussion is of value and interest to everybody concerned with electric circuits

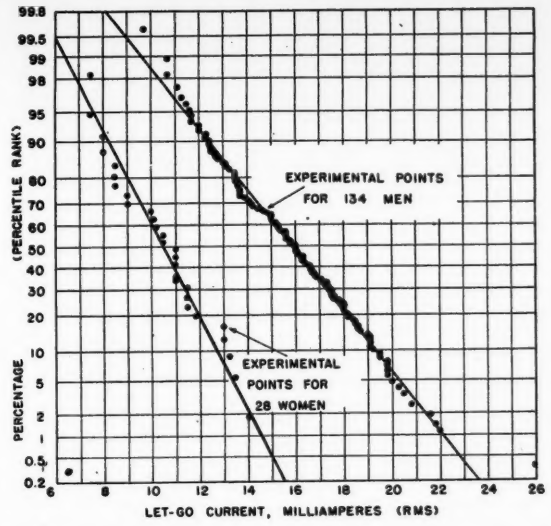


Fig. 1. 60-cycle sine wave "let-go" current distribution curves for men and women

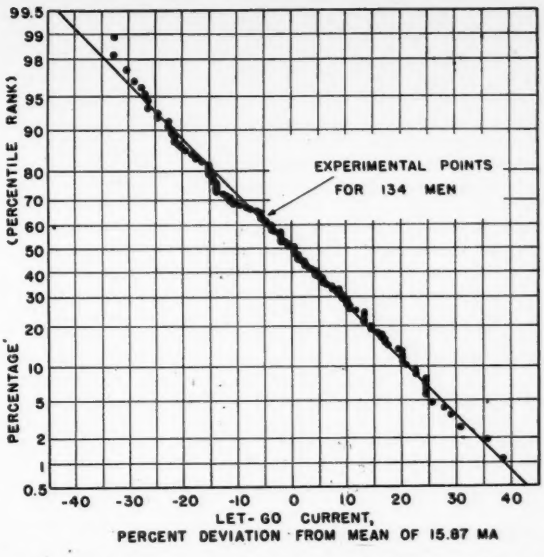


Fig. 2. 60-cycle sine wave "let-go" current deviation curve for men

as evidenced by the many persons who have been resuscitated successfully.

Ventricular Fibrillation

Much valuable information on currents producing ventricular fibrillation has been obtained from extensive experiments performed on animals at Columbia University by Ferris, King, Spence, and Williams.[4] These authorities have adeptly described the fibrillating condition as follows:

"Currents somewhat greater than those just necessary to stop respiration by action on the muscles may cause fatalities, even though the duration of such shocks is but a few seconds or less—far too short to be important from the standpoint of interruption of respiration, and obviously too short to give any opportunity for rescue before the end of the shock. Death under such conditions is brought about by ventricular fibrillation, which is a disruption of normal heart action. This condition is an unco-ordinated asynchronous contraction of the ventricular muscle fibers in contrast to their normal co-ordinated and rhythmic contraction. It results from an abnormal stimulation rather than from damage to the heart. In the fibrillating condition, the heart seems to quiver rather than to beat; no heart-sounds can be heard with a stethoscope —the pumping action of the heart ceases; failure of circulation results in asphyxial death within a few minutes."

Most of the experiments were made on sheep, calves, pigs, and dogs, in which chest dimensions, body weights, heart weights, and heart rates were comparable to those of man, although several species of smaller animals, including guinea pigs, rabbits, and cats, were included to establish the general trend of effects with weight and other physiological factors. Foremost of their findings from the practical point of view are:

1. The susceptibility of the heart to fibrillate depends on the phase of the heart cycle at the instant the shock is applied.

2. Repeated shocks are not cumulative in their effects on the heart, and the heart generally returns to normal in about five minutes if fibrillation does not occur.

3. The results on the whole indicated that sinusoidal currents in excess of 100 milliamperes at 60 cycles from hand to foot would be dangerous for shock durations of three seconds or more.

The statement establishing the threshold current producing ventricular fibrillation in man at 100 milliamperes for 60-cycle sine wave shocks of three seconds or more has been quite generally accepted by the profession. Without any thought of depreciating the value of this conclusion, it is fair to say that much is yet to be desired in the way of additional information, with special regard to the variation of effects with shock duration, wave form and frequency.

Before proceeding with an analysis of fibrillating currents, it is helpful to review certain conclusions found in the "let-go" current experiments.[2,3]

"Let-Go" Currents

Experimental points representing "let-go" currents for 134 men and 28 women are shown in Fig. 1, in which the ordinate gives the percentage of subjects

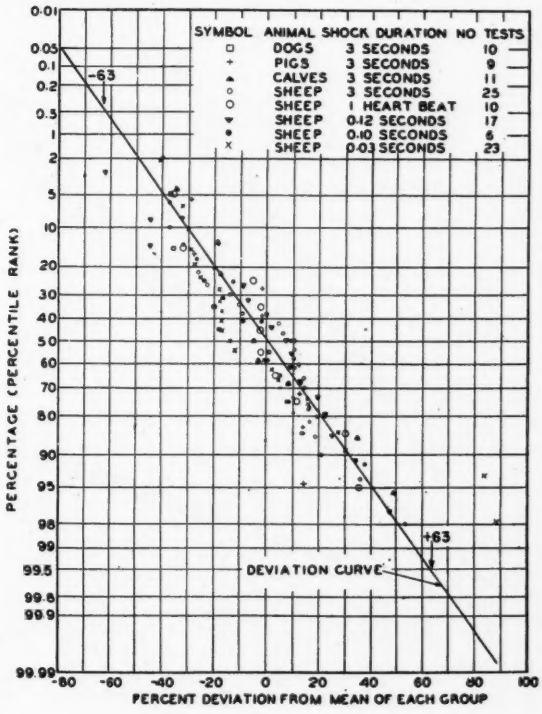


Fig. 3. 60-cycle sine wave fibrillating current deviation curve for various animals

who can release their grasp of a conductor carrying the current shown in the abscissa.[2,3] It is important to emphasize that a sufficient number of points was obtained to determine a normal distribution, as evidenced by the fact that the data closely follow a straight line when plotted on probability paper. Figure 2 shows the results for the 134 men plotted as per cent deviations from 15.87 ma, the mean of the group. The straight line governed by the majority of the points of Figure 2 has been called the Deviation Curve. When points representing the women were plotted as per cent deviation from the mean of their group, it was found that they followed a deviation curve having the same slope. Similar results were found for composite waves consisting of a mixture of alternating current and direct current, for rectified 60-cycle sine waves, and for sine-wave alternating currents from 5 to 5,000 cycles. This finding is important because it permits improved accuracy in predicting results for large groups based on a relatively small number of experimental points.

This procedure was used to study 60-cycle fibrillating currents obtained by Ferris and his associates. Figure 3 shows fibrillating currents plotted as per cent deviations from the mean of each series, respectively, for eight different tests. Although the distribution of the points does not line up as well as that found for "let-go" currents, it does establish that a definite trend exists. This holds for the four species of animals for three-second shocks, and for the sheep for shock durations of 0.03 to 3.0 seconds. It is entirely possible that the same trend might also hold for shocks of various durations for the other animals, and for man.

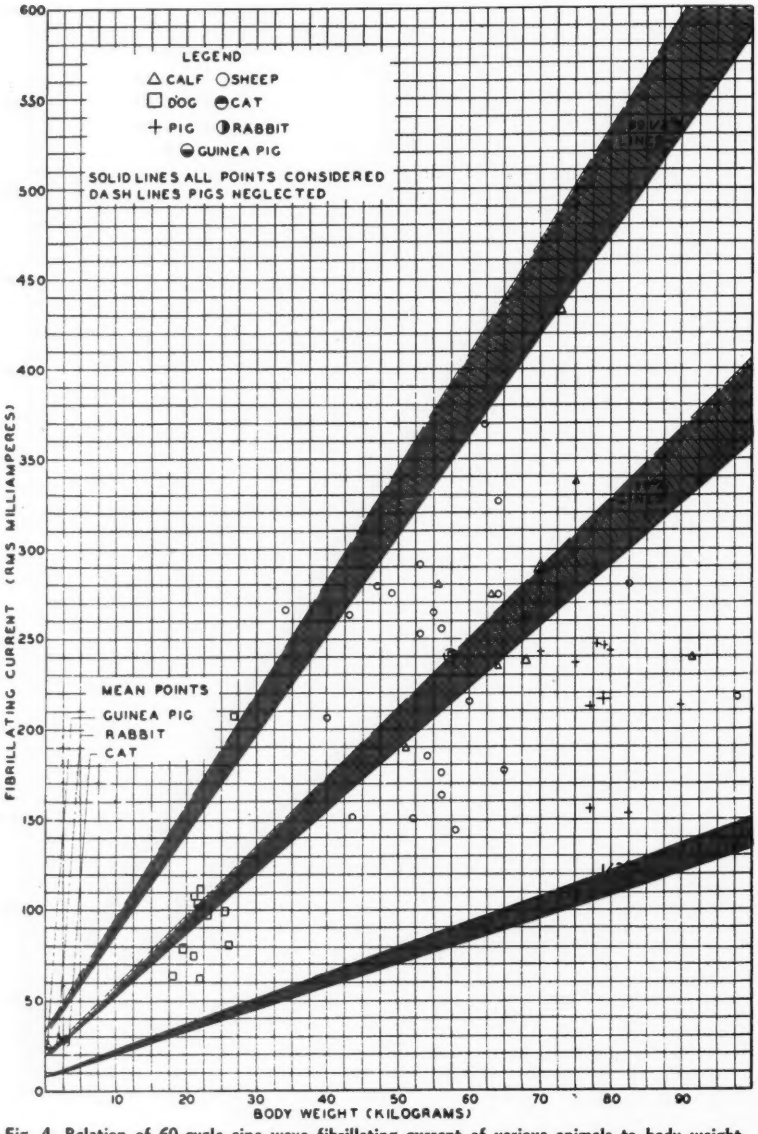


Fig. 4. Relation of 60-cycle sine wave fibrillating current of various animals to body weight. (shock duration 3.0 seconds)

Because of the small number of points available for any test, the straight line governed by all the points was drawn to determine the deviation curve. Apparent discrepancies of a few of the points from the deviation curve are believed due to the small number available for any single test, to experimental errors in applying the shocks at the most susceptible phase of the heart cycle, to the rather wide variation in body weights, and to other factors which are properly included in the term "biological variability."

The fibrillating current for an animal was taken as ½ (minimum current causing fibrillation + maximum current not causing fibrillation). It is believed that the value so obtained should be reasonably close to the current just required to produce fibrillation during the most susceptible phase of the heart cycle, and the statistical method of analysis should minimize errors.

The current pathway for these experiments was between the right foreleg and the left hind leg. Experiments were also made using four other pathways; namely, across the chest, chest to foreleg, head to hind legs, and between both hind legs. For the current pathway between the two hind legs, the portion of current reaching the heart was evidently too small to produce fibrillation for currents within the operating range of the equipment. Differences in values for the other pathways did not appear great enough to be significant, and it was concluded that results obtained for the pathway between the foreleg and the hind leg should be sufficiently accurate for most engineering purposes.

Fibrillating currents for three-second shocks for seven species of animals versus body weight are shown in Figure 4. Points representing the larger animals total 55, and none were discarded. The smaller animals were represented by average values only, as data for these cases were not furnished the author. The 50 per cent line was drawn by inspection through the points representing the means of the various tests. The author is still in doubt as to where to draw the best line, and the analysis was carried on from here, using a broken line neglecting the points for the pigs, and a solid line in which the effect of the pigs was weighed by eye. The fact that the upper line passes very close to the points representing the averages for each of the other six tests is believed significant. It is unfortunate that only nine pigs were used.

In spite of the wide scattering of individual points, it is evident that in general the fibrillating current is proportional to body-weight. Similar variations were encountered when studying "let-go" currents, but all efforts to find a correlation with age, weight, strength of grip, or arm measurements, were without conclusive results; however, higher values were obtained on well-developed individuals having the appearance of good health. Other things being equal, it is believed that both "let-go" currents and fibrillating currents should

Table showing results of impulse tests on animals

No. of Animals	Age	Est. Weight Lbs.	Open Circuit Voltage	Condenser Charge Millicoulomb	Animal Resistance Ohms	Avg. No. of Shocks	Remarks
Spring lambs. Contacts—metal electrode on lips to rear feet in bucket of salt water.							
10	4–6mo	72	1400	18.2	550–1750	3	
10	4–6mo	70	1600	20.8	550–1750	3	3 sheep stunned for 5–15 sec*
13	4–6mo	72	1750	21.0	550–1750	3	1 sheep stunned for 5–15 sec*
6	4–6mo	72	1750	22.7	550–1750	2	1 sheep stunned for 5–15 sec*
Pigs. Contacts—insulated feed through to rear feet on wet earth							
1		180–200	1400	4.2			
25		180–200	1400	7.0		4	
1		215–225	1000	10.0		1	
2		215–225	1200	12.0		1	
1		215–225	1600	16.0		1	
25		215–225	1750	17.5		1	
1		215–225	1400	16.8		1	
12		215–225	1750	21.0		1	pig stunned for 60 sec*

* Animals were stunned on third or fourth consecutive shock.

at least be roughly proportional to size and weight.

The hazard due to direct current is of increasing importance due to the greatly increased use of d-c welding equipment and high voltage power supplies. The ratio of average d-c "release" to 60-cycle "let-go" currents is about 4.8 to 1. Ferris and associates determined the direct current required to produce ventricular fibrillation in 11 sheep for three-second shocks. The ratio of average d-c to a-c fibrillating current was 5 to 1.

Condenser Discharge Shocks

The danger from condenser discharge is of vital importance. It is generally believed that the initial current and charge are of prime importance in determining the hazard. The time constant of the circuit and the stored energy may also be important, but no data are available on this phase of the subject.

Reference (5) contains an account of studies made by the author in the attempt to determine the hazard due to impulse currents. The investigation was made to determine the hazard of condenser discharge electric fence controllers and included a survey of human accidents on lightning generators. A few condenser discharge tests were made on male volunteer subjects on voltages up to 1750. Impulse tests using larger condensers were made on spring lambs and pigs. Table I shows some of the data obtained from tests made on the animals. No fatalities were experienced and higher power was not used due to limitations of equipment. No attempt was made to co-ordinate the shocks with the sensitive phase of the heart-cycle. However, because of the large number of shocks applied, it is reasonable to assume that they were distributed throughout the heart-cycle, and probably many occurred during the sensitive phase.

The criterion proposed for defining dangerous current thresholds is based on the current which might produce ventricular fibrillation in ½ percent of a large group of normal adult men. The choice is of course arbitrary, and any other number could be selected. There is no intention to be hard-boiled about the remaining ½%; however, one has to stop somewhere, and the ½ percentile was considered a reasonable stopping point. Perhaps the best justification for choosing the ½ percentile is that it was used in estimating reasonably safe "let-go" currents and provoked no adverse comment.[1,2,3] As previously mentioned, all available experimental data were carefully analyzed and, in instances which required special judgment (such as just where to draw the best line to determine the general trend of a response), an attempt was made to adopt procedures which would give a conservative final result. Several different attempts were made to correlate the data, but the method proposed is believed to be the best that can be done. It is indeed unfortunate that statistical predictions must be expressed numerically, as there is a tendency to place too much emphasis on mere numbers. Quite aside from the uncertainties of the present analysis, there remains the important uncertainty of transferring results obtained from animal experimentation to man. However, data from numerous human accidents, although meager and inconclusive, seem to indicate that the proposed threshold values are conservative. It is the author's opinion that currents much in excess of the proposed threshold values must be considered very dangerous to human life.

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FURNACE EXPLOSION IN WATER TUBE BOILER CAUSES $30,000 DAMAGE

CARELESSNESS in lighting-off a gas-fired water tube boiler resulted in a furnace explosion that seriously injured the operator and caused property damage estimated at more than $30,000.

The fireman had received orders to run the induced draft fan for five minutes before lighting-off the boiler, and had promptly thrown the switch to start the fan motor. Five minutes later he reported that the fan had been running the required time and he was then instructed to light the pilot under the boiler. When the torch was placed in the furnace, a violent explosion resulted. The fireman was blown across the boiler room suffering from burns about his head and from severe shock.

Blast Blew out Front Wall of Building

The force of the blast blew out the front wall of the building and also the wall of a building across the street. The steel casing around the boiler was demolished, the steel stack was loosened and tilted at a dangerous angle and the fire doors and furnace walls on an adjacent horizontal tubular boiler were blown off. Two 12 in. I-beams beneath the bottom drums of the water tube boiler were bowed out of line 3 in. and 6 in. respectively, the bolts holding the casing and brick work to the boiler were sheared and the boiler itself was forced several inches rearward.

Factors Leading to Explosion

There were two principal factors leading to the explosion, one of them being that the operator who threw the switch for the fan motor neglected to observe that the motor never did start. A power interruption had occured in the area prior to the time the switch was thrown, but this fact had apparently not been observed in the plant. The other circumstance is that the furnace of the boiler was filled with gas. It is not known who turned the main gas valve one quarter open or when it was done, but it was found in that position after the accident. The operator stated that he had merely turned on the gas pilot light a matter of seconds before the explosion.

It is fortunate that additional damage to the plant did not result from fire following the accident, and the circumstances preventing such additional damage are interesting. A 30 mile-per-hour wind was blowing at the time of the explosion, and when the front of the wooden building and the casing of the boiler were blown out, the wind forced back into the boiler the flames that sprang from a broken 3 in. gas line. In a short space of time, the gas was shut off at the main valve where the line entered the building and serious fire damage was undoubtedly prevented by the fact that the flames were directed against the boiler instead of against any part of the wooden building.—THE LOCOMOTIVE.

Cincinnati's Mill Creek Flood Control Project

Unique solution to Cincinnati's flood problem involves an electric pumping plant with six 6500 hp motor driven pumps . . . Pumps are largest of their type ever constructed, rated at one billion gpd . . . Unusual controls open siphonic discharge gates simultaneously with pump acceleration . . . Project involves sewage control during flood time

By H. B. McDERMID

THE PROTECTION from the back water effects of the Ohio river floods by means of the Mill Creek Barrier Dam is an achievement of a high order, because of the many problems involved. The solution arrived at is believed to be new as to its conception, and is certainly unique in its design.

To get a clear picture of the project, a quick overall view of the terrain must be presented. Greater Cincinnati is a town of perhaps a million inhabitants, mostly situated on high hills well above any possible floods but through its original location as a small settlement runs the valley of Mill Creek, coming in from the north, very little above the Ohio river at low water, and into which it flows. On this creek's flood plain is said to be situated about 40 per cent of the city's manufacturing industries, subject to high floods from the Ohio's back water, as well as its own flash floods, and all the damage that goes with them, including in the 1937 record flood, the disastrous large fires fed by oil from overturned tanks. This oil was fired by sparks from a trolley, and some idea of its magnitude is had from the fire chief's report made after fighting it all day; he said, "fire is under control; there is only a spot a mile wide and four miles long burning now." So the floods and their attendant damage were well worthy of control.

The Ohio river in the vicinity of Cincinnati has been made into a series of pools at low water, by installing a number of dams as an aid to navigation. When the river is at "Pool stage" or lowest possible point, the gage reads 12 ft; its record flood in January 1937 was 80 ft, due to the heavy week long rains, pouring off the steep watershed both above and below the city for hundreds of miles. The Ohio here runs between high hills with practically no flood plain, so when heavy continuous rains cascade off those roof steep hillsides, there is no place for the river to go but up—and it goes up with a vengeance.

The plan at Mill Creek was to build a barrier dam across its mile wide valley at its confluence with the Ohio, crossing the creek, seven city streets and thirty railroad tracks, all of which had to be open at low water and closed at high water in the Ohio, so no floods could back up the creek valley, yet the normal business of the district could go on without interruption during low water periods. All sewers in the valley above the dam on both sides of the creek had to be led into intercepting channels, discharging into the creek above the dam, so that the main Ohio floods could not back up through the sewers, and so render the dam useless.

Having solved the problem of keeping the Ohio waters out was only part of the solution. It immediately brought up another question: "What to do with the water coming down Mill Creek, also certain to be in high flood from its steep watershed?" The only possible answer was to pump these heavy flash floods over the dam into the main river channel. To handle this situation, there was installed a huge pumping plant, fully capable of raising this heavy volume over the dam fast enough to always keep the creek's flood plain dry, so no matter what floods might occur, the industries in the valley might stay safe

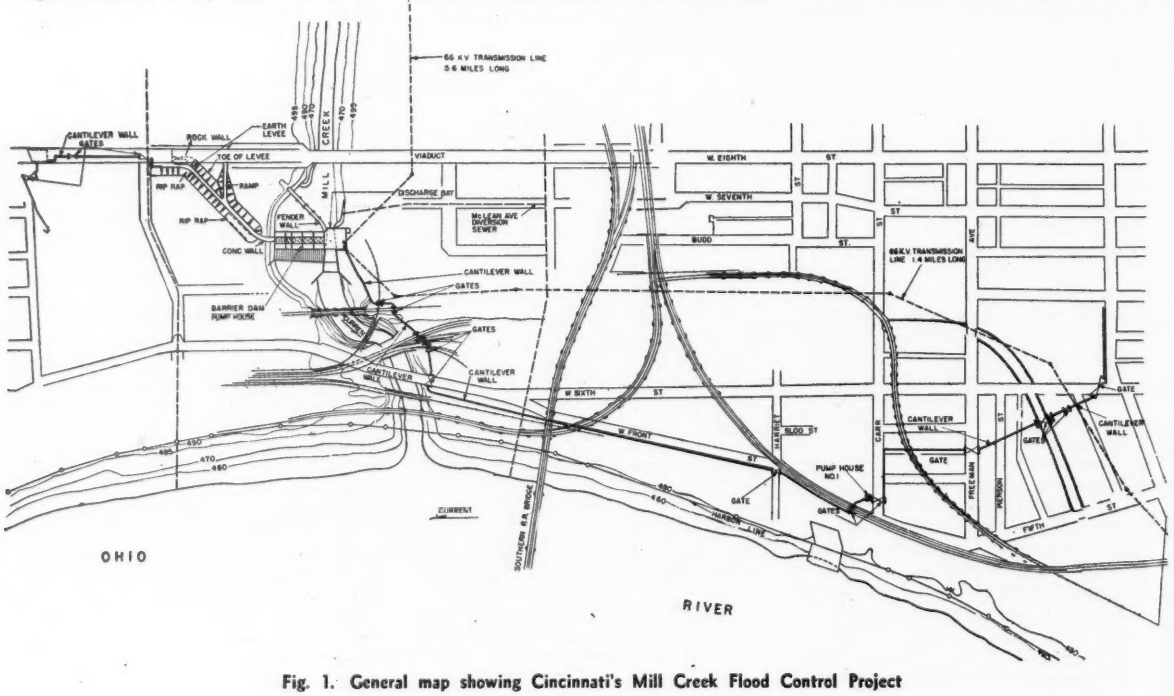


Fig. 1. General map showing Cincinnati's Mill Creek Flood Control Project

from harm from their actions.

This work has been begun and carried well forward by the U. S. War Department Engineers, and is now so well advanced that the new concrete channel for the creek, some 45 ft wide by 75 ft high, together with the steel bulkheads for closure and the gantry crane for their handling, is completed, as is also the pump house and the west end of the dam. The eastern end is still under construction.

The pump house, 45 ft by 270 ft in plan, contains six completed units which are believed to be the largest of their type yet constructed. They will take care of any floods coming down Mill Creek as long as the present pondage remains undisturbed. Should the pondage be reduced by owners filling in their property to provide room for expansion, space for three additional units which will take care of the increased demand, has been provided. Each unit is capable of pumping 1500 second feet (1,000,000,000 gpd) against a head of 29 ft, which capacity is raised to 1850 second feet or 1,188,000,000 gpd when the differential drops to ten feet. These S. Morgan Smith pumps have impellers ten feet in diameter, with fixed vanes which discharge axially upward through a six vane diffuser, and through double discharge tubes and gates, nine feet square out through the dam. These pumps are driven by 6600 v, 60 cycle, 3 phase, 6500 hp General Electric synchronous motors through 18 in. 180 rpm shafts. The twin siphonic discharge gates are normally closed against the Ohio river, being opened as the motor starts by automatically operated oil hydraulic hoists, to whose piston rods they are directly connected.

Built-in control boards on the motors provide indicating thermometers for all bearings, and the stator coils. The steady bearings are provided with automatic Alemite grease lubrication. The thrust bearing oil bath and its cooling water are also equipped with indicating thermometers so that the operating temperatures of any vital part can be noted by the attendant at any time. All thermometers are equipped with high temperature alarms which shut off the motor when any of the component elements reach a predetermined dangerously high temperature.

The Westinghouse switch gear is built-in for each unit, and is so arranged that the only manual operation for a start is to throw a finger long lever through an arc of about 60 deg, the rest of the action being automatic. As the start is made, the stator is thrown across the line at full voltage, and at the same instant, the hydraulic hoists are started, to open the discharge gates. At about 5 per cent opening, the hydraulic surge of the main pump takes charge of the gate opening till the gate is about 75 per cent open, when the action stops until the oil pressure in the hydraulic hoists again catches up and completes the opening. As the motor reaches about 95 per cent synchronous speed, the field energizes at 250 v, the current coming from one of two 250 v, 800 amp motor generator sets, each of which is able to carry the full load in the station so one can always be held in reserve. As the field is energized, the conditions are such that the motor torque is considerably greater than the pump torque so that the unit slips into step with only an allowable line voltage disturbance. On shutting down it has been found that the discharge gates close easily by gravity as soon as the oil pressure beneath the hydraulic hoist pistons is automatically released, but the pistons can be operated manually to the closed gate position by oil pressure if found necessary.

Current for the relays of the switch gear is furnished by storage batteries, kept constantly and automatically charged by a direct current generator, driven by a gas engine. The entire station is served by a 25-ton overhead traveling crane of conventional design. Upstream from the pump house, as shown in the photo, is a concrete diversion screen to hold the heavier debris away from the pumps, while the conventional steel bar trash racks at the pump suction openings provide protection from the finer trash. A feature of this installation is the traveling gantry crane, powering a cleaning device, shown in the sectional view of the units and pump house.

West of the pump house is a short section of concrete dam and joining this and running diagonally upstream to the Eighth street highway viaduct at the point where it crosses Evans street is

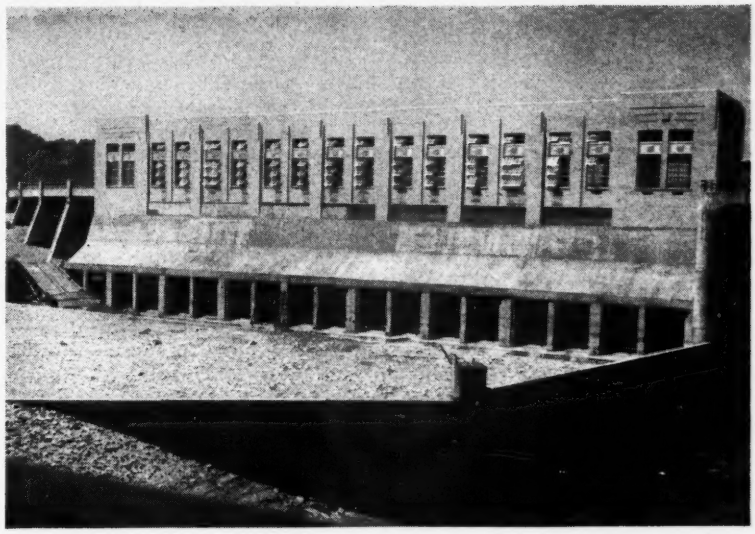


Fig. 2. The South or Ohio River side of the pump house. The discharge openings are shown below

Fig. 3. Interior view of the pump station looking west

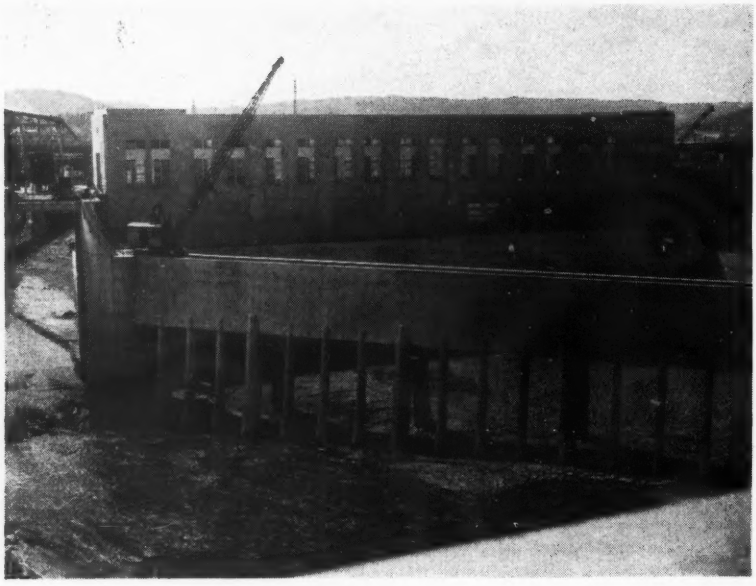


Fig. 5. (Left) A view of the forebay side of the plant

an earth section some 700 ft long. The foundation for the earth section ran into a fill about 50 ft deep, making it necessary to excavate to original solid ground at this point and then re-fill with clay. This clay was solidly packed in place with a sheep's foot roller to the crest, some 65 ft above the bottom of the excavation. From Evans street west under the viaduct concrete is again used until the high ground at that end of the work is intersected, cross several railroad tracks on the way. The crest of the dam has been established at about 83 ft gage, as the record flood for all time is 80 feet and large control basins are being built on the Ohio tributaries, upstream, that will materially reduce flood crests with the same volume of storm water.

East of the pump house is the transformer platform where one transformer for each unit is installed; below this platform is the storage space for the

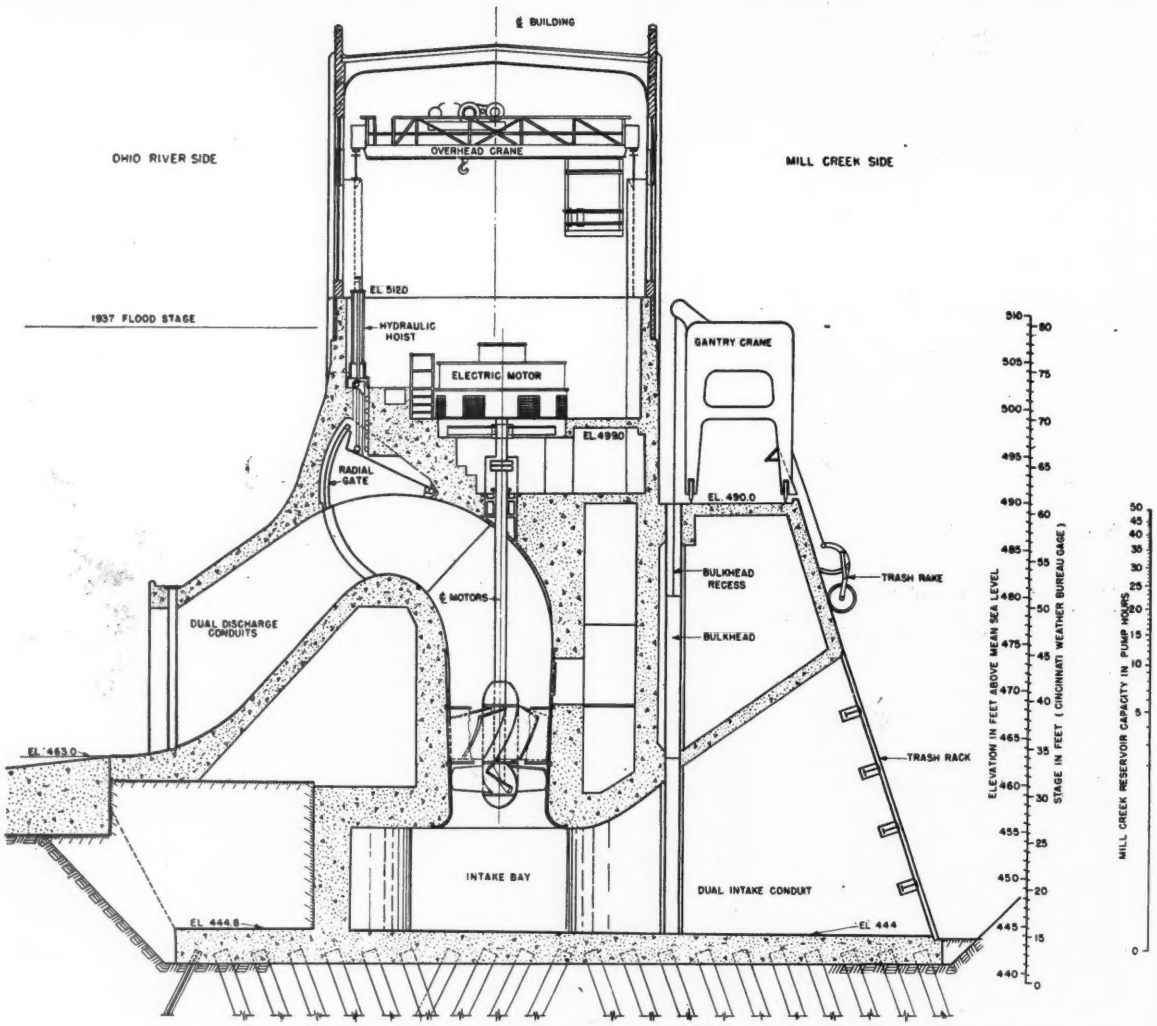


Fig. 4. Cross section through the pump house showing the billion gal per day vertical pumps. The pumps discharge upward through a 6-vane diffuser and then through twin siphonic discharge gates

bulkheads which close the concrete creek channel, and the gantry crane for handling these 45 ft members up and down in their 75 ft deep slots in the sides of the channel, and carrying them to and from their storage racks. From here to the eastern end the dam is built of concrete, turns sharply down along the east bank of the creek toward the Ohio, and then meanders generally east around railroad and highway bridges and viaducts and their approaches and all the manifold obstructions of a heavily built up industrial section, aiming to give the greatest possible protection and the least possible detriment to the greatest number of industries, until it ends at the high ground nearly a mile away, on the east side of the flood plain. This eastern end is now in the process of construction, and is expected to be finished before next spring's floods.

Considerable construction work was involved in the placing of the intercepting sewers on both sides of the creek; that on the west, called the Evans street sewer, is six feet in diameter and drains the comparatively few sewers into Mill creek at all times; the east side is served by a 12 ft sewer normally into the Ohio, but has an intercepting channel leading above the dam into Mill creek in time of flood. A 12 ft gate shuts off the branch to the main channel and prevents back water from entering through the dam in high water. Photo gives an idea of the magnitude of the necessary tunnel job.

Plates for closing off the seven city streets and thirty railroads were designed in aluminum alloys, to facilitate quick handling when the time came that these openings had to be closed. To aid in sealing the edges of the plate, the slots holding them are set on a decided slant, so the weight of the water would more firmly seat the hand placed plates against the rubber belt gasket which forms the seat on the sides. Where railroads are involved, the sill is set at the top of the rail, with the rail itself setting on a cork bed in the sill. Along the bottom of all gates, and also around the sides of the rails on railroad gates, sand bags form the final seal. All gates are sufficiently reinforced on the upper sides at the centers of the spans by diagonal braces to hold the alignment of the plates against the water pressure. A large crew will be necessary for the rapid closure of these nearly forty openings, but once the advantages of keeping Mill Creek bottoms dry in time of high floods is demonstrated, there should be no lack of adequate help in a critical semi-public emergency of this sort.

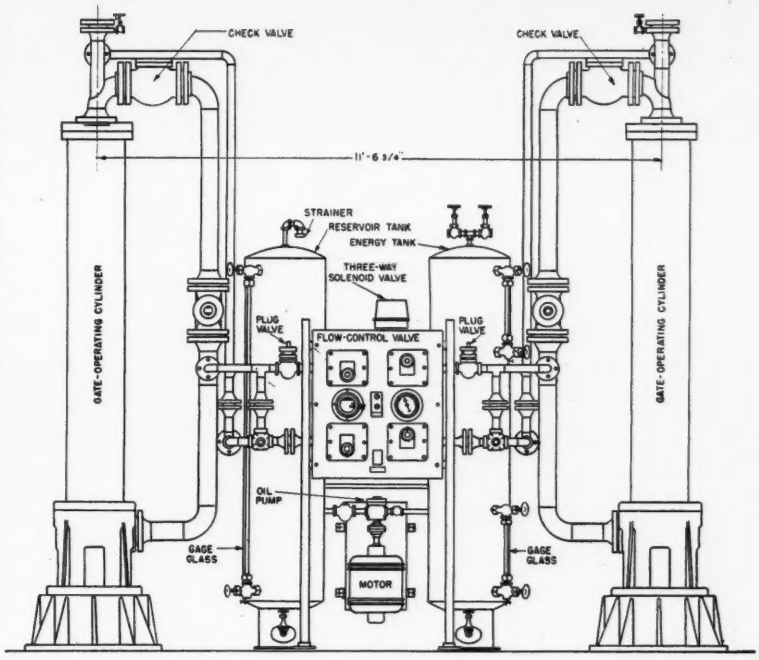


Fig. 6. Radial gate operating assembly. This hydraulic system operates one pump's two radial discharge gates. This shows the oil-energy reservoir and energy tanks between the two gate-hoist cylinders

ALCO DIESEL LOCOMOTIVE BUILT FOR SANTA FE RAILROAD

THE 75,000th locomotive built by the American Locomotive Co. at Schenectady, N.Y., was completed on September 18 and was exhibited at the private siding of the Waldorf-Astoria Hotel in New York on September 22, 23 and 24. This 6000 hp Alco-GE Diesel-electric locomotive weighs 450 tons, is capable of traveling at a speed of 120 miles per hour, and will go into service on the Santa Fe Railroad between Chicago and the West Coast. Six other such units are under construction. The new line includes the 6000 in three single-engined units of 2000 hp each, a three-unit 4500 hp locomotive for fast freight service and a single unit 1500 hp combination road and switch locomotive. Engines are of four Cycle design and make use of constant pressure supercharging. The 6000 is made up of three units, an "A" unit with operator's cab, a "B" unit without a cab and another "A" unit. With this combination no turn-around is required. The "A" unit alone has a capacity of 2000 hp, is 65 ft 8 in. long, 14 ft 11 in. high, and has starting tractive effort of 61,000 lb. General Electric Co. furnished the electrical equipment.

How to Control Marine Growths in Circulating Water Systems

AS POINTED out, by John G. Dobson in the article under the above title in the August, 1946 issue, no new growth of fouling organisms will occur on any plant structure unless the spat form, which is capable of free swimming, is present in water. Naturally, these forms are only present when the adults of the organisms involved are breeding.

The data given in the attached chart were collected from the extensive records of the William F. Clapp Laboratories in Duxbury, Massachusetts.

This non-profit institution has been operated by Dr. Clapp since 1918. At the present time, they are maintaining approximately 500 observation posts covering the entire United States coastline.

The work of the laboratory is supported entirely by voluntary contributions by various industrial plants who feel that the laboratory contributions to the general knowledge of marine borers and fouling organisms are of value.

A test panel consists of a series of five soft-wood panels, each 6 in. by 12 in. by 1 in. thick. These panels are mounted on permanent supports and held in place at a given depth. On the same day of each month, the one month control panel and one other panel are removed and forwarded to the laboratory for identification of borers and fouling organisms present. In this way, the laboratory is able to judge what new organisms have established themselves during the month's period and also to judge the growth which has occurred during the 5-months' period of the organisms which have established themselves during previous months.

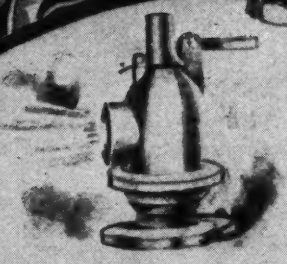
Data taken from one part of a harbor are not necessarily applicable to another part of the same harbor, or data collected in any season may not be applicable in another season. Changes of tide, food condition, mud cover on the bottom, water temperature, and many other factors affect both the number of organisms which will breed in a particular place and the number of offspring that are capable of surviving.

This is strikingly illustrated by the two charts covering different parts of New York Harbor. Therefore, only if the data covering fouling organisms have been collected at the exact spot where some proposed industrial plant is to be erected and, further, provided that the industrial plant will make no important contribution to the flow within the estuary or to the temperature of the water, can data of this type be used with any degree of reliability for design purposes.

HARBORS	ORGANISMS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
BOSTON, MASS.	HYDROIDS					■	■		■	■	■	■	■
	BRYOZOA							■	■	■			
	WORMS											■	■
	BARNACLES						■	■	■	■	■	■	■
	MUSSELS								■	■	■		
NEW YORK I	HYDROIDS							■	■	■		■	
	BARNACLES	■	■	■			■	■	■	■	■	■	
NEW YORK II	HYDROIDS			■	■	■	■	■	■	■	■		
	BRYOZOA					■							
	WORMS		■								■		
	BARNACLES		■	■	■		■	■	■	■	■	■	■
	MUSSELS							■					
BALTIMORE, MARYLAND	HYDROIDS		■		■		■	■	■	■	■		
	BRYOZOA									■			
	WORMS		■						■				
	BARNACLES		■	■	■			■	■	■	■		
	MUSSELS									■			
CHARLESTON, S. CAROLINA	HYDROIDS	■	■	■	■	■	■	■	■		■	■	
	BRYOZOA						■						
	BARNACLES	■	■	■	■	■	■	■	■	■	■	■	■
MAYPORT, FLORIDA	HYDROIDS	■	■	■	■	■	■	■	■	■	■	■	
	BRYOZOA					■					■	■	
	BARNACLES	■	■	■	■	■	■	■	■	■	■	■	
	ANOMIA												
PENSACOLA, FLORIDA	HYDROIDS	■		■	■	■	■	■	■	■	■	■	■
	BRYOZOA												
	BARNACLES	■	■	■	■	■	■				■	■	■
	ANOMIA								■			■	
	OYSTERS						■	■			■		
GALVESTON, TEXAS	HYDROIDS	■	■	■	■	■	■	■	■	■	■	■	■
	BRYOZOA	■							■	■			
	BARNACLES	■	■	■		■	■	■	■	■			■
	OYSTERS												
CORPUS CHRISTI, TEXAS	HYDROIDS	■	■	■	■	■	■	■	■	■	■	■	■
	BRYOZOA				■	■	■	■	■	■	■	■	
	BARNACLES		■	■	■		■	■	■	■	■	■	
	OYSTERS									■	■	■	
LOS ANGELES, CALIFORNIA	HYDROIDS								■	■	■	■	
	BRYOZOA									■	■	■	■
	MUSSELS						■						
SAN FRANCISCO, CALIFORNIA	HYDROIDS					■	■		■	■	■	■	■
	BRYOZOA												
	WORMS												■
	BARNACLES					■	■	■	■	■	■	■	■
SEATTLE, WASHINGTON	HYDROIDS	■					■	■	■				
	BRYOZOA						■	■	■				
	WORMS												
	BARNACLES					■	■	■					
	MUSSELS												

Chart of fouling periods in a number of American harbors, supplementing data shown in Fig. 3, page 72, August, 1946 issue

The Practical Engineer



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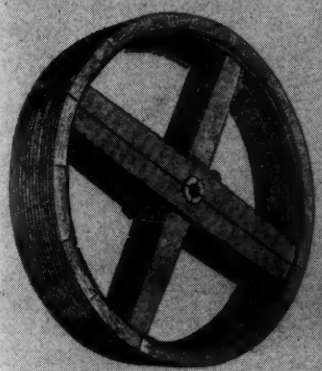

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50 YEARS AGO

Power Plant ENGINEERING

POWER PLANT ENGINEERING 50 YEARS AGO

This year, 1946, marks the 50th anniversary of Power Plant Engineering. As the cover on the reverse side of this page shows, originally, the paper was known as the Practical Engineer and it was partly for that reason that today we retain the name Practical Engineer for the section of Power Plant Engineering specifically devoted to the interests of the operating man.

The Practical Engineer was started in 1896 as the official journal of the American Order of Steam Engineers with headquarters at 1213-15 Filbert Street in Philadelphia. The subscription price at that time was 50 cents per year —30 cents a half year. As explained in greater detail on another page of this section, in 1908 the Practical Engineer was purchased by the three men who founded the Technical Publishing Company and, in 1918, the name was changed to Power Plant Engineering.

IN THESE FEW PAGES we carry you back over the years to give you a glimpse of the way times were 50 years ago, what engineers were thinking about, what their interests were, how they worked. Compared to present-day standards, their interests were very simple, yet to them everything was new and complex and their problems were quite as formidable and hard to solve as ours are today. Their Corliss and slide valve engines, their primitive mechanical stokers in the few cases where they had them, their "boiler compounds" and belt dressings presented as many headaches as do our high pressure boilers and turbogenerators today, more in fact, because today we have much more basic data in regard to the operation of all our high powered equipment. In those days, 50 years ago, knowledge of materials was meager and as a consequence there were many accidents. Boilers exploded with tragic regularity and cylinder heads "let go" more frequently than was pleasant. Read Sam Hills account of the accident at Greylock Mills at North Adams, Mass. on October 4, 1897 and you will see why life in the power plant was exciting in those days.

They Also Had Fun

Engineers worked hard 50 years ago. They were at the plant early and late and they put in much time overhauling equipment and polishing brass work. And yet they had fun—they seem to have gotten more "kick" out of running their plants than do operators of modern plants. Often, too, they were men of importance in their community. As *engineers* they occupied a position in society that accorded them respect and a degree of envy; they knew about dynamos and arc lamps, mysterious things to the average citizen, and this knowledge gave them prestige.

Nearly all belonged to some fraternal order, some engineering "brotherhood" and they assembled often and enthusiastically to discuss their mutual problems, to visit and eat with each other. There were no meat shortages in those days; pork chops were ten cents a pound and potatoes 15 cents a peck. They ate well and often, and they had fun. Listen to this—this was when a "jovial party of good fellows" from Maryland Council No. 1 of Baltimore visited Philadelphia on October 24, 1897. * * *"After the visiting brothers were all assembled in the reception rooms, together with about a hundred of the Philadelphia boys, dinner was announced and all repared to the dining hall where an elegant dinner awaited them with a number of beautiful young ladies (previously engaged by Brother McDowell), to look after the interests of the guests." Brother McDowell obviously knew what the boys liked and in that respect times have not changed any.

Trolley Cars and Breweries

The "boys" of those days liked to ride the trolley cars. No meeting or convention was complete without a trolley car ride. In the case of the Baltimore boys cited above, "the party boarded special cars and went to Fairmount Park * * * then around on the park trolley cars to various other places of interest."

Some of the finest power plants of those days were those serving breweries. These always had refrigerating equipment of considerable size and aside from the mechanical interest which they afforded there was an opportunity to test samples of the product. Again referring to the Baltimore-Philadelphia party, "after the visitors had departed a number of local members visited the handsomely equipped refrigerating plant of the Germania Brewing Co., on Broad Street above Columbia Avenue, where the always courteous and efficient foreman, Gust Huber, conducted the party through the plant showing them all the improved appliances which have recently been adopted, and eventually rounding up where a sample of the brew, which is conceded to be the finest produced in the city, was disbursed to the party."

Mobile Cylinder Heads

Life, however, was not all pleasure for the engineer fifty years ago. As already mentioned, there was a lot of hard work to be done, much more than at present because there was little automatic equipment in those days. Stokers were few and far between and hand firing was the rule. There was little in the way of automatic control and the equipment was not always reliable. Flywheels burst quite frequently and cylinder heads did not stay where they belonged. Here is Sam Hills account of the accident at Greylock Mills at North Adams, Mass. * * * "At 3:15 p.m. October 4, the cross head upon the high pressure side of the Cross Compound Condensing Buckeye Engine at the Greylock Mills, North Adams, Mass., let go about two inches back of the pin. The piston knocked out the cylinder head, the follower plate was broken and the spider cracked. All

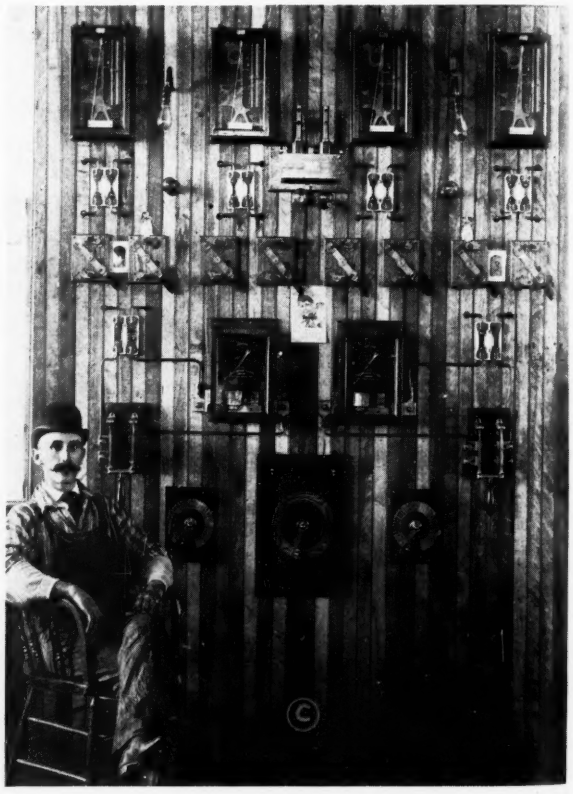


Fig. 1. Here is an electrical switchboard of 50 yr ago. The proud operator wore the standard power plant headgear of the period and the standard facial adornment

Fig. 2. Advertising pages from some of the earliest existing issues of the Practical Engineer such as November 1897, January 1898

the studs holding the head to the cylinder, excepting four were broken off. False head was cracked but not broken. The cylinder escaped without being injured in the least. The piston did not leave the cylinder and evidently did not strike the head but once, as it was at the head end of the cylinder when the steam was shut off. It evidently did not return to the crank end of the cylinder as the break in cross head did not show any evidence of having met the piece which was left in the guides and making its travel back and forth in them at every revolution of the engine. The false head went across the room a distance of twenty feet, knocked a hole through a ten inch brick wall and dropped at the engine room side of the wall. The smaller pieces of the outside head were found scattered all over the room. Engineer S. L. Hills had just stepped out of line of the head and was standing in a doorway about five feet from the line of the flying head. Fireman Chalifion was in the pump pit which is directly in line with the cylinder but about seven feet lower. The false head fell within two feet of him at his left hand. Engineer Hills instantly realized what had happened and rushing to the top of the boilers shut off the steam." * * *

The Angel of Death

Engineer Hills was just lucky. At another time he might have been in line with the head and then he would not have written this account. Somebody else would written his obituary, and at the next meeting of the brotherhood suitable resolutions would have been made eulogizing his accomplishments. They really went in for that sort of thing in a flowery way. Here, for example is the way Peter Thompson was eulogized when he died of dropsy at the age of 43. * * *"Death thus removes one of our oldest and most esteemed members, one who will long be remembered for his devotion to the Order for his honesty and integrity. At the regular meeting on Monday evening, October 18th, the following resolutions were passed:

Whereas, the angel of death has taken from our midst our esteemed and worthy Brother, Mr. Peter M. Thompson. *Whereas,* he has been a most active worker, *Whereas,* in private life he was always a most exemplary man, commending himself to his employers by his faithfulness and efficiency, etc. etc., and then follows a number of *Resolveds* placing his attributes on the record, draping the charter of the Council in mourning for 30 days, extending heartfelt sympathy to his family, etc., * * *

Parades

Fifty years ago parades were exciting things and almost every occasion demanded a parade with floats and bands and red, white and blue bunting. Consider this excerpt from the November 1897 *Practical Engineer.* * * *"October 12 is here and Syracuse (N.Y.) is in gala attire. It was 50 years ago that Syracuse became a city (It make it just 100 years today) and today all one can see is red white and blue with which her citizens have decked their places of business and residences.

The parade, which was the largest ever seen here, would have been much larger and finer if it had not been for the heavy shower which came just as most organizations were beginning to form, and which ruined many floats—ours included. John E. Sweet Council No. 6, had one of the finest turnouts, and many flattering comments were heard along the line of march. First came a float, drawn by four magnificent horses, which contained a Straight Line Engine in active operation with indicators attached. A Whitman and Barnes Boiler with Engine attached—using oil for fuel. The next carriage containing Professor John E. Sweet, Past Supreme Chief Engineer, N. M. Skinney and Deputy Supreme Chief Engineer, W. F. Merrill. This was followed by the Collamer Cornet Band of 20 pieces and last but not least the members dressed in the engineer's regulation suit of blue overalls, frock and black silk cap, which made them look fine—one woman spectator exclaiming, 'I did not know overalls could look so nice.'" * * *

Much of the material in the early *Practical Engineer* was devoted to methods of setting valves and keeping engines in efficient operation. There was also considerable "educational" material, courses in simple mathematics, in physics and elementary electricity. This was in the days before engeering colleges and few of the men employed in power plants knew very much about higher mathematics. Even such simple things as "short" and " long division" were explained in great detail.

Here, for example, is an extract from a course in Practical Mathematics which ran in the *Practical Engineer* in 1897. * * * *Problem I.*—Divide 684 by 2.

Solution.—Write the 684 and draw a line beneath and a curve to the left. Thus)684. Now place the 2 to the left of the curve. Thus 2)648. 2 is contained in 6 three times, because 3 x 2 = 6. Write the quotient 3 beneath the 6. Thus, 2)684
3

Then say 2 is contained in 8 four times; place the 4 beneath the 8. Thus, 2)684. And so on. * * *
34

This example, perhaps, more than anything else, indicates the primitive state of engineering 50 years old. It may still be true that there are men in some power plants today who would not know how to do short division. Even today such simple things have to be explained in technical magazines devoted to the industry.

Power Plant of 50 Years Ago

Fifty years ago, in most power plants, steam was generated by horizontal return tubular boilers, Scotch boilers and in some cases, vertical fire tube boilers such as the Manning and the Wickes. It is true that the water tube boiler of the straight tube, cross drum or longitudinal drum type was beginning to come into use. But water tube boilers were used only in the very largest and most progressive plants and were definitely radical and new design. By far the majority of plants employed fire tube boilers.

It is interesting that in one of the very early issues of the *Practical Engineer*, the plant description of the power plant for the Stephen Girard Building in Philadelphia showed a very modern and advanced design using water tube boilers, and most advanced of all, chain grate stokers for firing them.

Fire tube boilers were usually of 100 to 150 boiler horsepower capacity and, of course, were almost always set entirely too low with brick settings of such small combustion volume that they seldom could exceed their rated capacity. The rate of combustion per cubic foot of furnace volume was not considered essential in furnace design and in fact for a long time the average furnace was too small despite the valiant work of a number of leading engineers to study the principles of combustion and apply them in practice. Coal and ash were handled largely by hand in small tram cars, wheelbarrows and such devices and labor saving equipment such as conveyors was seldom used because labor and fuel were relatively inexpensive. Feedwater heaters were rarely seen in the average small plant, although in some plants closed-type feedwater heaters were installed with reciprocating feedwater pumps. These, however, were definitely in the minority 50 years ago.

THE PRACTICAL ENGINEER.

POWER PLANT

Stephen Girard Building, Philadelphia.

Fig. 3. Selected pages from a very early issue of Practical Engineer, showing pages describing a very advanced power plant for that day, articles on steam engine indicator and valve setting

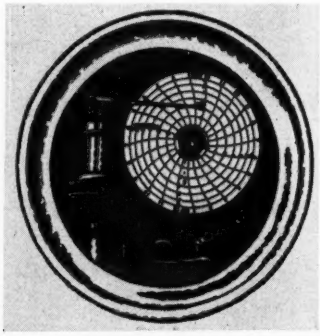


Fig. 4. A draft recorder of 50 years ago. In this instrument was "a small cylinder in which a practically frictionless piston operated under the influence of the draft," the piston motion multiplied by an attached arm carrying a reservoir filled with ink, which was kept in contact with "a chart of paper held in position on a circular plate, which is caused to rotate by a system of clockwork"

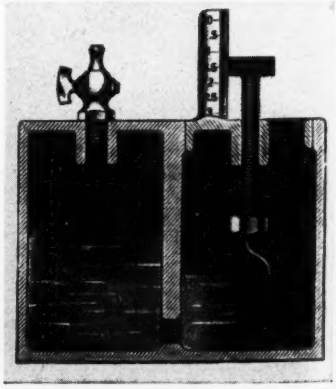


Fig. 5. A U-tube draft gage of 50 yr ago in which the difference in water level between the two chambers, produced by the draft, was measured by a hook gage

Water was usually fed to the boilers by means of a good old Hancock "inspirator" or some other make of injector.

Smoke issuing from the stack was not considered objectionable or an indication of poor combustion.

Boiler scale on heating surfaces of all kinds was a nuisance because if it became too thick, it had to be removed to prevent bagging of boiler shells over the fire or blistering of tubes. Boiler compounds of unknown chemical content were fed to the boilers in an effort to reduce or prevent the formation of scale. The chemical content of feedwater was unknown and the prevention of scale was consequently a cut-and-try process, sometimes resulting in foaming and priming in the boilers.

In most power plants steam was generated at a pressure of 92 to 100 psi and was delivered to one or more reciprocating engines of the slide valve, piston valve or four valve type with a flywheel belted or roped to a line shaft, which drove various units of manufacturing equipment. In the central station the generators were more likely to be direct-connected to the engines.

Condensers were used with central station engines and turbines. Many of these were of the barometric type and some were of the barometric jet type with rather complicated air pumps and "hurling-water" pumps.

In industrial plants if a condenser was required it was frequently of the barometric type, if water was readily available. In a great many cases, however, the steam was exhausted to atmosphere or partially used to heat the manufacturing plant building during the heating season.

Electrical Equipment

Direct current generators and motors were in most common use at this time. The Stephen Girard Building plant, shown in Fig. 3, employed direct current generated by "dynamos," direct connected to Porter Allen automatic cut-off engines developing between 150 and 300 IHP each. In most plants the engines were belted to the generators or dynamos.

Alternating-current, single-phase had been introduced into the field about 1890 but was used alomst exclusively for lighting. The single-phase motor had not been sufficiently developed at this time to be of much use except for small fans.

However, the single-phase equipment was rapidly displaced by the development and introduction of polyphase machines, both two and three phase, for which no fixed standard of frequency was established. This condition gradually settled into the present generally accepted standard of 3-phase 60 cyle frequency.

Switchboards were fearful and wonderful contraptions 50 years ago for they were all open with open knife switches, fuses, and even bus bars right on the front of the board ready to electrocute the unwary operator. Steel enclosed circuit breakers and all the modern devices for handling electric circuits were a long time in coming. Even as late as 1924 or 1925 enclosed electrical equipment was still very radical design.

Questions and Answers

Questions and answers were a feature of the *Practical Engineer* of 1896 and 1897 as they are of the *Practical Engineer* of 1946. Here are a few of the questions and answers found in an early issue of the *Practical Engineer*.

"Question: What is the smallest amount of coal needed to produce one horsepower hour?"

"Answer: The best record made by a land engine was 11.67 lb. of steam per horsepower. Tests have shown more than 12 lb. of steam produced with one pound of coal. With a combination of multiple expansion engines and boilers equipped with both hot draft and very modern feedwater heating appliances, a record of 0.999 lb. of coal is claimed. This is probably the figure for main engines only. It is the auxiliaries in a plant which are really wasteful of steam and the coal consumption, as usually stated, includes all steam apparatus from the main engine to the point where the power is transmitted from the plont."

"Question: Should the water be fed into a Scotch boiler in the steam or water space?"

"Answer: Into the water space below the water line. If you feed it into the steam space the chances are greater that part will be carried over into the engines. The correct point at which to admit the feed is a matter about which a difference of opinion exists. A distributing pipe fitted above the water line is likely to be shattered in a very short time if the feed is intermittent.

"Question: Please state a rule for finding the velocity of flow of water in a pipe?"

"Answer: The following formula is what is required."

$$V = 48 \times \sqrt{(h \div 1)} \times D$$

"In this formula V equals the velocity of flow in feet per second, h equals the head of water in feet, 1 equals the length of pipe in feet, and D equals the pipe diameter in feet. The rule is divide the head in feet by the length in feet, multiply the product by the diameter in feet, extract the square root of the product and multiply by 48. The product will be the velocity in feet per second."

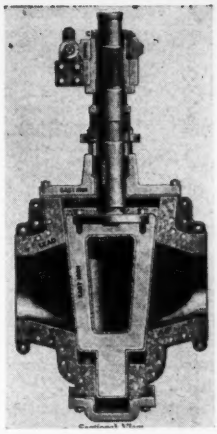


Fig. 6. A gigantic stop cock.

Modern engineers who have to take into account the Reynolds number and other factors discovered more recently about flow of fluids, will be amused at the simplicity and forthright assurance of the above answer. But that was what they knew at the time and, for the conditions under which they worked, was probably accurate enough.

One of the most interesting and important things to note in looking over the pages of the first *Practical Engineer* magazine, is that we are still concerned today with a great many of the same problems that confronted the power engineer of 1897.

Safety Precautions

Take, for example, the whole subject of safety in operating power equipment. In the October 1946 issue of POWER PLANT ENGINEERING is a fine article by Robert Henderson Emerick on this subject, followed in the November issue by a paper on Safe Boiler Operation, by Max H. Kuhner.

But turning back to the first two or three issues of *Practical Engineer*, some of which are shown here,. we find an editorial in the November, 1897 issue discussing Safety (?) Elevators, pointing out that intelligent care and maintenance of elevators was a responsibility of engineers and should not be left to janitors as they had been in a good many cases.

"For many years past" the *Practical Engineer* of November, 1897 informs us, "engineers have been petitioning our various law making bodies to protect human lives by the passage of laws requiring that competent men be placed in charge of steam boilers. The small success that has attended their efforts is well known to most of our readers and yet through all of these years the destruction of life and property has continued incessantly until the record of devastation by steam boiler explosions and accidents to machinery is enough to make Nero himself turn in his grave." It should be noted that this question of the need for competent operators, who know the right things to do and how to do them in an emergency, is one of the principal points in the discussions of both Mr. Emerick and Mr. Kuhner in 1946.

Another interesting point well brought out by Mr. Kuhner in the November 1946 issue, was the necessity for operators not putting the wrong procedure into action in an emergency. Here is a little item from the November 1898 *Practical Engineer* illustrating that very point. "On an engine in a small plant the cylinders were equipped with snifters or safety valves on the cylinders. While the engineer was in another part of the building and a young man from an adjoining room was asked to keep his eye on things, the safety valve on the head end of the cylinder began to blow. The young assistant ran for a monkey wrench to increase the tension of the spring thinking that the valve had been reduced below the safety valve pressure. Just then, however, the engineer heard the pop of the snifter and knew it was not caused by rising boiler pressure because he had not been away from the engine room long enough for the boiler pressure to rise more than 60 pounds whereas the snifter was set to blow at 80 pounds.

So first looking at the steam gage, which read 60 psi he

The Practical Engineer.

PUBLISHED ON THE FIRST OF EACH MONTH

American Order of Steam Engineers,

SOCIETY NOTES.

THE PRACTICAL ENGINEER.

Fig. 7. Selected editorial pages from earliest existing issues of the Practical Engineer. Note the subscription price on the "masthead"

turned his attention to the exhaust valve at the head end of the cylinder. He found lying on the bed plate of the engine the key which belonged in the valve and crank arm. This had dropped out and as a result the exhaust valve had failed to open and the exhaust was blowing through the safety valve."

The commentator concludes, with typical engineering understatement, "Had the engineer been a little later and the assistant more indiscriminate in his use of the monkey wrench on the safety valve, the consequences may be imagined."

The Steam Turbine and the Steam Engine

Here too in an early issue is a complete detailed treatment of American stationary steam engines. Sixty-two pages each 9½ by 13 in., are devoted to details of every known make and type of engine showing details of frames, cylinders and pistons, valves, valve gear, instructions for setting valves, complete details of the various mechanisms, table of mean effective and terminal pressures, theoretical and actual steam consumption in condensing and non-condensing Corliss engines, similar details for low speed, medium speed and high speed steam engines, the various types of governors, etc.

Although the steam turbine was beginning to be developed at about the turn of the century and a great deal of work was being done on it both abroad and in this country, it was still a radical innovation and we do not find any mention of it in the pages of the *Practical Engineer* or its successor *The Engineer* until about 1901, when articles began to appear discussing the fundamental principles of the steam turbine and, shortly after that, descriptions of actual turbines that were being built and installed.

Fundamentals are still fundamental. In one of the early issues is a detailed article in starting up a new power plant. It tells, how to test the boilers with cold water pressure after erection before they are ready for firing, what to do if anything is found amiss, how to warm the boiler up and get it on the line, how to handle the various valves and fittings, how to make sure the steam lines and valves are free from dirt, metal chips and other obstructions, how to get the engine into good operating condtion, how to inspect and overhaul the lubricating system, how to make sure that the packing is all ready to operate properly, details of boiler feed pumps and open heaters, what to do about the condenser if there is one, etc.

That sounds amazingly like the discussion by Mr. Gore of how a modern steam generating unit is made ready for service, appearing on page 99 of the November 1946 issue.

Valve setting for all types of engines was an important subject 50 years ago and right in the first issue of *Practical Engineer* we find an article on the subject beginning with a discussion of the simple slide valve and going on to the other types in later articles. Some of this material is reproduced in Fig. 3. Similar treatment was given to details of boilers and their auxiliaries.

Draft Gages

An interesting article in the January 1898 issue covered, in very good detail for that time, the subject of draft measurement. After explaining what draft was and how it was measured by a water column, or a U-tube gage, the author showed two or three draft gages available at that time. One is the Sturtevant gage capable of measuring up to 20 oz. of pressure. For very small differences of pressure the gage shown in Fig. 5, embodied the measurement of water level in two legs of the U-tube by means of a hook gage. However, even at that time, recording draft gages, such as the Crosby gage shown in Fig. 4 were available.

New Equipment a Feature

New equipment being introduced by manufacturers has been a feature of the magazine right from the earliest issues. This is another fundamental, for engineers must know what equipment is available to meet various requirements and cannot attempt to carry out procedures and designs for which equipment cannot be obtained. So it was natural that right from the beginning the *Practical Engineer* should carry a large amount of detailed technical information on new products. The foregoing pages show a couple of interesting items of this kind. A new surface gage of interest to all men concerned with repair and maintenance is described in detail. Since the average power plant of that time almost always did a large amount of its own maintenance and repair work, the entire subject of tools and methods of using them was of vital interest.

Another interesting item is the description of a Kieley & Mueller damper regulator. That was about the extent of the

combustion control equipment available for boiler plants at that time. There were, of course, elementary steam pressure regulators, pump regulators and a few other devices of that kind but they were a far cry from the sensitive, powerful and stable automatic controls of today, which developed from them.

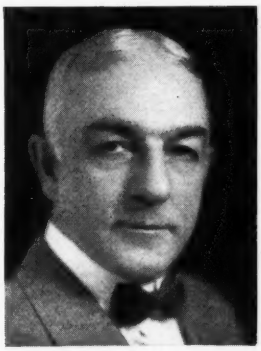
An interesting device of the period described as "a gigantic stop cock" shown in Fig. 6, was fully described in an early issue. This had to withstand the tremendous pressure of 100 pounds per square inch, be fabricated of a material that would resist the action of water strongly impregnated with sulfuric acid and of a size suitable to fiit in a 16-in. line. As shown in the illustration, the plug of the valve was lined with lead and the valve body was made in two parts lined with lead and bolted together with heavy wrought iron bolts. To overcome the pressure due to the head of water, a lead-lined by-pass valve around the plug was provided. The valve plug spindle was provided with a thread and an arrangement of worm wheel and crank for raising the plug from its seat rotating it, thus enabling one man to open or close it.

There were articles on Requirements of Electricity in Manufacturing Work, running through several issues; another on The Practical Application of Superheated Steam; Detailed Instructions for Centering a Piston in a Cylinder; Description of Systems of Steam Heating; Detailed Description of the Principles of the Induction Motor.

One radical had the temerity to write an article "Are Wrist Plates Necessary on Corliss Engines" and demonstrated, probably to the horror of a great many of his readers, that they were not.

In the early *Practical Engineer* articles on the softening of feedwater for boilers, more details of steam engine cylinders and valve gear, description of a new steam economizer, a forced feed lubricator, an automatic low water alarm, tube cleaners, gage glass preservers and other devices. As we go along in the early issues, we find more frequent mention made of the use of stokers, often chain grate types, and more attention devoted to the principles of combustion. As the months went by, there began to be more discussion of steam turbines, for we find in an early issue in 1901 an article showing the original turbine of Hero of Alexandria and illustrating the principle of the reaction turbine. This article also described the principle of the impluse turbine, brought out in 1629 by the Italian, Giovanni Branci, and then went on to describe a new steam turbine as developed by DeLaval.

Arthur L. Rice



Edward R. Shaw

Charles S. Clarke

A BRIEF HISTORY OF POWER PLANT ENGINEERING

By K. L. RICE
President, Technical Publishing Co.

SHORTLY after the turn of the century, a magazine called "*The Engineer*" was purchased by the Taylor Publishing Co. of Cleveland, Ohio. Arthur L. Rice, who had served as Assistant Secretary for the American Society of Mechanical Engineers and had attracted considerable attention through his free lance writing, became Editor of "*The Engineer*." Edward R. Shaw and Charles S. Clarke were star advertising salesman for the publication. Shortly thereafter, the Taylor Publishing Co. moved to Chicago.

Early in the year 1908, Mr. Taylor decided to retire and sold "*The Engineer*" to McGraw-Hill Publishing Co. By that time, Mr. Rice, Mr. Shaw and Mr. Clarke had found that they were not only unusually congenial, but made a very effective three-man team in creating and selling the kind of a magazine needed by engineers. They were faced with a very important decision—should they continue with "*The Engineer*" under new management, or should they strike out for themselves?

"*The Engineer*" was combined with the magazine, "*Power*," and consequently lost its identity. This meant that there was both room and need in the field for a highly practical type of publication serving the power engineers of that period. It was found that a rather obscure publication in Philadelphia could be purchased and the three young men decided to form their own company and buy "*The Practical Engineer*."

The Technical Publishing Co. was born in the spring of 1908 with Mr. Shaw as President, Mr. Rice as Treasurer and Editor, and Mr. Clarke as Secretary.

"*The Practical Engineer*" had been started in 1896 as the official organ of the American Order of Steam Engineers. Strangely enough, the original owner was also a man by the name of Rice although he was no relation to Arthur L. Rice. During the first ten years of its ownership by the Technical Publishing Co., from 1908 to 1918, great strides were made in the size, character and influence of the publication. Those were the days of steam engineering, but electricity was rapidly becoming more important to all phases of power generation and application. Power engineers also were rapidly emerging from the mechanic class to more of a professional status. Their daily engineering problems became increasingly complex and technical, requiring more and more education, background and technical experience.

"*The Practical Engineer* had kept ahead of all of these developments in its editorial services so, in 1918, it was decided that the name of the paper should be changed to better express its true editorial scope and function. The name was changed at that time to POWER PLANT ENGINERING, which it has remained ever since.

For thirty years, the Company maintained its own composing room in order that every detail of mechanical operation should be under direct control. In 1938, the service of printers had improved to the extent that it was no longer necessary to maintain this separate operation. The Company maintained the same printing contact with Excelsior Printing Co. from 1908 until 1942. This was one of the longest continuous printing contracts in Chicago, and it was only discontinued because of the fact that the original owner died and new management of the printing company resulted in its bankruptcy in the spring of 1942. Another very long term contract is the paper contract with West Virginia Pulp & Paper Co. which has been in continuous existence for more than thirty years. It is an interesting sidelight on the acumen of the founders that these business relationships were established at the beginning of the Company's operation and that both printing and paper needs were placed with such progressive firms that they kept up with the ever-progressing needs of publishing without the need for changing sources.

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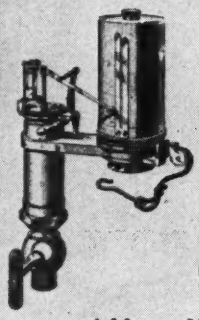

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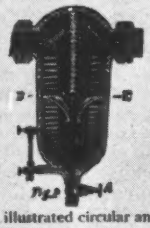

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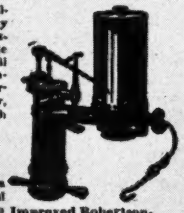

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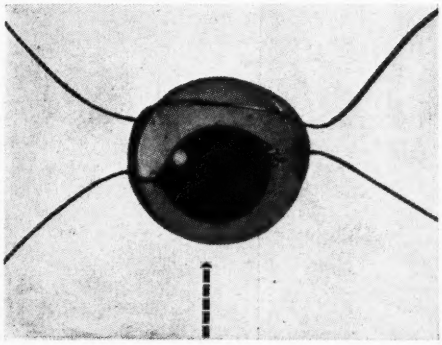
Fig. 8. Here is a reproduction of the entire back page of an early Practical Engineer. Note that you either make your own indicator—with a little assistance—or buy one all ready to operate. You could also obtain a handsome pack of playing cards by saving labels from packing

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR



A MILLIONTH OF A DEGREE

Every once in a while we run across something which seems so simple that we wonder why somebody did not think of it before. One of these gadgets is shown here. It looks like an eye and in a certain sense it is an eye for it keeps an eye on the performance of certain delicate instruments in long distance telephone circuits. It is called a "thermistor." It consists of a speck of metallic oxide imbedded in a glass bead no larger than a pin head and mounted in a vacuum. The thermistor was developed by Bell Telephone Laboratories to keep an eye on the amplification in long distance telephone circuits.

When a thermistor is heated its resistance to electric current changes rapidly. That is its secret. Connected in the output of repeater amplifiers, it heats up as power increases, cools as power decreases. This change in temperature alters the resistance, in turn alters the amplification, and so maintains the desired power level. Current through the wire at the top provides a little heat to compensate for local temperature changes.

During the war new uses for this device were found. It can detect temperature changes of one-millionth of a degree. In one instance, Bell Laboratories scientists developed a thermistor which could "see" the warmth of a man's body a quarter of a mile away.

It is not probable that most of those reading this will ever have occasion to measure temperature changes of a millionth of a degree but if it ever becomes necessary, here is a little device that can do it.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
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They Made Power-- But How?

Bark in the cooling water; the cooling water warm; the management cool—all these and not Heaven, too, were the lot of the chief engineer in this saw mill power plant. When a new staff took over the operation things began to happen. The new chief knew how to get management's cooperation and it took a lot of it to get things swinging again

By R. L. BROWN

IF ONE would journey through this power plant as a visitor, the first thing coming to one's mind, would be the way the equipment is painted and the outward semblance of perfect order, (even the power factor meter approaches unity once in a while).

But underneath all this exterior polish you would notice the tension—the chief engineer pacing the floor and chewing the stub end of an unlit cigar, the head operating engineer meeting the chief as they nervously stroll around and around that turbine room.

Why are they so nervous? They seem to be expecting something to happen at any moment. And this something happens every now and then.

It so happens that I spent several months at this particular plant as an operator in this same turbine room. It is the power plant for a saw mill. The reason for this plant being so liable to go haywire without a moment's notice, is because it is overloaded to the point where it is always a game of perhaps. If they cut logs that aren't too high in moisture content, the fireman can usually manage to keep the steam up—with the help of fuel oil.

This particular saw mill hasn't been in operation too many years, having been built and put into operation somewhere around 1939. Whoever planned this plant in the first place seemed to have a peculiar idea regarding the term horsepower or kilowatt.

To begin with, this same company suffered a loss by fire of their entire plant several years previous to the construction of this new plant on the hill. The reference to the new plant being on the hill is because it is located about 30 miles from the old mill site and most of these miles are up the crookedest road I ever drove over in my life.

The altitude at the mill on the hill is around 3000 ft. That means plenty of snow during the winter months. You can leave the village with the rain pouring down but before you have gone very far it is necessary to stop the car and get out and put on the chains in order to get through the snow. All of this wouldn't be so bad if the road was wide enough to pass other cars. In order to pass one had to wait at designated wide places in the road or drive over the cliff into the canyon below.

The 85 F water available here does-not condense the steam very good and the water isn't some that has been in the pond or has been used to cool anything. It enters the town site by coming down a ditch several miles long and what isn't used for domestic purposes is allotted to the power plant and the mill pond.

At the time that I was employed there the water ran direct into the mill pond. We took our cooling water for the surface condenser and glands from this pond.

It used to be the regular job of the operator to run out to the entrance screen with a rake and scratch off the bark, every time he noticed the sump (from where the circulating pumps took their water) getting low. If the operator didn't get the bark scratched away from the screen in time, well, that meant a shut down. Some fun we had those days.

This screen trouble was causing lots of lost time. Naturally the management seemed to think that something had to be done. It's funny how the management of some of these saw mills only want to start the power plant up and then sit back in their swivel chairs and watch the money roll in.

Sometimes it doesn't roll in so fast if there is trouble making the power. It was up to the chief to figure out something—it usually is. The management makes the mistakes in the first place and the chief, poor soul, must be forever racking his brain to correct these mistakes.

It's a funny thing, although the chief is the fellow that management always wishes to see when there is trouble with the power, it would have been just too bad if he should have butted into their conversation at the time that the power plant was being constructed, with a suggestion that would be the means of saving the company a good many dollars and the chief himself a lot of headache.

Here in this plant the same old story was repeated. The chief tells them that he must build a dam and separate the clear water from the bark to stop mixing the logs and the water for the turbines and boilers, so as to keep the make up water as clean as possible.

It took several days of argument before the chief finally convinced these fellows that his idea would actually work. So a bulldozer was brought into play, also a crew of men. There was a flume all ready for the transportation of hot water from the condenser outlet to the upper end of the pond. This flume was about ten feet high at the power house and ran on a gradual fall to the water level of the pond. Something like a hundred yards. We fenced off about an acre of pond so as to get rid of the bark, but then our troubles began again. The water was too hot in the pond to condense the steam when the full load was on, the vacuum falling to 14 in. at times.

The chief had told the management of his plans in the beginning when the mill was being built. This included the separate dam for the cooling water, also the fluming of the mountain water direct into this pond, with a gate to transfer the coolest water directly into the sump serving the condenser pumps.

Now they were perfectly willing to hang this matter of the hot water right around the chief's neck. Things didn't get any better as this was in the late summer, the weather was hot and all the water was low, as well as warm. There was another 1250 kw low pressure turbine being installed at that time, which was to assist the 2000 kw, 150 psi turbine, but this low pressure unit wasn't ready to be put on the line. It looked like considerable work.

Yes, the events that followed can be figured out very easily. Things went from bad to worse. At times we would lose our vacuum and have to shut down until things got cooled off a bit. This caused a lot of trouble in general. All of the power house was motorized with the exception of the air compressor which was steam driven. Naturally when the turbine went off the line the motors went with it.

The fuel house chains all stopped. The crew had to get busy and carry some wood around to the boiler room, in any fashion—on their shoulders, wheel barrows, etc. After a time the steam was brought up to 150 psi and then another attempt was made at making some more power for the mill.

Sometimes we succeeded in keeping the turbine on the line for a spell, but not always. All of this didn't make the management very happy. Somebody had to be the goat, so the fellow with the big cigar went after the chief. Do something or else, says he! The chief took the "else." A lot of the other men did, too!

The new chief sure had his hands full with the vacuum trouble, new plant and a lot of new men. However, this fellow wasn't any fool. He knew something about a plant too. The coolest water that could be found had to be available for the circulating water for the surface condenser. By this time some of this had begun to sink into the manager's head, so he gave the order for the chief to go ahead.

They then built a flume from the ditch that brought the water down off the mountain. This was arranged to empty into the sump.

When this job was completed, there was considerable improvement in the operation of the power plant. The vacuum was somewhat better but the only time it even went over 24 in. was when the main load was off and the sawmill and planing mill were shut down at the end of the shift.

Of course, by this time it was fall of the year and the water was considerably colder. There was frost almost every morning.

It wouldn't be long now before they were going to put the low pressure exhaust turbine on the line. By the way the manager strutted around with the big cigar in his mouth, one would think that it was he who really had the situation in hand. That may have been what he thought, I don't know, but he sure was in for a rude awakening.

To begin with this particular power plant was heavily overloaded. They had three Stirling-type boilers; two of 500 blr-hp and one of 450 blr-hp. The number of motors that had been hooked onto this battery of boilers was a fright. Also, there were eight big dry kilns of about 100 blr-hp each, not to count the hundreds of feet of uncovered bare steam pipe.

This saw mill being a double mill there were two carriages in the mill —that meant two shotguns. These were 14 in. in diameter.

The main band motors were 250 hp, the resaw 150, the edgers 150 hp, hog 150 hp, log haul 125 hp. Some of the dry kiln motors were 20 hp and some were 25 hp. It would take a couple of good men several days to count up the motors, as regards the voltage, serial numbers, their operating characteristics Some were 2200 v and some were 440 v. Believe me, it wasn't an easy job for a new electrician to figure out all of the circuits in that set up. Some of these motors gave a lot of trouble as they were the same ones that went through the fire at the old mill.

Of course, these particular motors were rewound, given a nice coat of battleship gray paint and the blessing of the owners. However this didn't always make them operate as cool as they should. Seems like the old rotor covers were used on a lot of these motors that went through the fire. I couldn't say whether the rotor laminations had been segregated and reinsulated or not. The only thing I know is that some of these motors gave a lot of trouble and when inventory was taken it was found that the ones giving the trouble were the ones that had been through the fire.

Of course, this wasn't any fault of the management, it was due to the lack of knowledge on the part of the head electrician. I was told that he didn't know his business; if he had hooked these motors up with the proper size wire set, they wouldn't have gotten hot.

This is a laugh. This particular man had been chief electrician for one of the largest power companies in California for over 15 years. If he didn't know anything, I don't see why they kept him so long. Well, anyway, he didn't stay long either. I hear he went back to the old job that he had before he was offered this job.

There were the planer motors to consider also. One large fan had a 200 hp 2200 v motor. A large planer had a 150 hp motor at 440 v, the small planer, 100 hp at 440 v. Also there were about 300 hp more on the resaws, trimmers, hog, cut off saws, filing room, etc.

This is not a complete thorough inventory of power used, but it will do to give the reader an idea of the power problem. The first chief engineer was wise enough to have installed flow meters, indicating the boiler horsepower used. There was one of these boiler horsepower meters on each boiler so the actual horsepower could be figured. There were times when there was as high as 3200 blr-hp indicated on all three of the boilers. However, a 24 hr average on the turbine room log usually showed 2500 blr-hp.

This plant also had to furnish power for the operation of a large machine shop about a mile away which I understand used on the average of 100 kw per hr when the shop was in operation. Then there was the woods' camp about ten miles up the mountain. There was a high line of 11,000 v running up to the camp, something like another 100 kw every day for the air compressor motors, water pump motors, the welding machine, overhead crane in the cat shop, etc.

There also was the town or camp load to be considered, sometimes running over 250 kw per hr. The system used in the making of the power at this plant was a lulu! The writer, not wishing to offend anyone, will merely say that should any of these items and accusations sound familiar to someone's ears, it is only coincidental and not meant for this fellow at all.

Now as to the men, there were three operators on the regular shifts to operate the turbines; a swing operator, who also relieved the fireman; one shift from each man each week; three firemen; six helpers; a boiler washout man; a clean up man; and a

"Oh, come on now, Cornish—your being in the Army didn't make you that tough!"

general utility man who did the oiling, etc., in the power plant.

A fellow would think that the boilers would be spic and span, but such wasn't the case. If they were accidentally found clean, it was because the chief had raised old Ned.

Seems like these fellows weren't too scared of the chief though, as this was after Pearl Harbor and being wartime, the chief hesitated to fire any of them, and if he had done so, he perhaps would have had the same old thing over again. It doesn't take long for the boys to get an education.

It seems like the men soon catch on when the plant is sick, so why should they care. The steam is always low anyhow. Why should they get into a hot combustion chamber and shovel out a lot of ashes, when they can get by just as well without doing it.

When it came to cleaning the flues, that was unheard of, too. Why clean them when there was a compound being used to remedy the scale situation. The chief didn't have too much time in those days to see to the boiler room as he was too busy getting the 1250 kw low pressure turbine ready for operation. He really believed, poor soul, that when he got this turbine on the line, everything would be O.K.

Talking about steam leaks, this place really had them. It didn't take but a little while until the valve seats on the valves were cut like a fellow had been working on them with a file. The poppet type valves used on the 2000 kw turbine were no exception, as during periods of light load these valves failed to seat properly at all times and there were times when the overspeed governor would trip the turbine.

Then the operators would try to remedy this by running the turbine with the main throttle cracked so as not to have all of the trouble of getting the turbine back on the line. This didn't work out so good because it wasn't long before the main throttle wouldn't shut off when we wanted it to.

This can be very annoying when a fellow has to get his face stuck down in around the carbon packed gland on the high pressure end. The writer knows this from experience. This carbon packing was always giving trouble. It was an old set that had been overhauled in the shop to fit the shaft on this particular turbine. The machinist at the shop bored the packing too large in diameter for the shaft by several thousandths. The chief decided to make it smaller by filing and using sandpaper which to the best of my knowledge never gave good service.

Finally a set of packing was obtained from the factory, then it was properly fitted for the correct clearance so as not to be too tight and seize the shaft and not so loose that it leaked excessive steam from the steam sealing gland. I don't believe that they have had any more serious trouble in regards to this packing.

It was about a week later that the 1250 kw turbine was ready to put on the line. The high pressure was turned on to get it to spinning because at the time the test was being made it was Sunday and the sawmill wasn't in operation. The idea was to bring it up to speed; using the small high pressure line.

This being a 3 in. line, it was also thought large enough to handle the town and the power house load. Which proved later to be correct but at that particular moment nothing happened. When the high pressure throttle was turned on the spindle just wouldn't turn.

After a lot of dumb looks at one another and several words said that weren't too nice, the management, at the Chief's suggestion, called a turbine engineer. It didn't take this man long to find the trouble. He had the generator end housing removed first, then the throttle was tried again just for luck and the spindle went to spinning free and easy. The trouble was with the end bell rubbing on the rings on the shaft and the rotor case of the generator. This was corrected by grinding and readjusting the clearances, then the housing was assembled and the turbine brought up to speed. After running for a period of about two hours a light load was gradually added. This turbine worked swell and it was thought that the power house trouble would soon be over.

However, when the turbine was synchronized with the 2000 kw machine the next morning, it was a different story. There didn't seem to be enough exhaust steam coming from the sawmill to keep it rolling and pulling its share of the load. Things might have been different if there had been a mixing pressure throttle on this machine but there isn't and it takes about three men and a couple of boys to start this turbine and to keep it in operation. Someone always has to be ready to close the exhaust valve and to open up a little on the live steam valve, just in case one side of the mill shuts down or the mill should close down for some other reason just for a few minutes.

The operator and the chief sure do a lot of foot work in this plant. It's no job for a man that likes to read the newspaper or his private detective story.

Did this exhaust turbine cure all of the trouble at this plant? It did not. It only added more. It was considerable time before the management got wise that they hadn't found a solution to their problem, but the fact remained that they just had to have more steam as it was a case of shut the dry kiln steam off everytime the steam got low or lose the turbines and once the condenser on the large turbine got hot it was quite a while before it could be put back on the line.

The chief wanted to install another 500 hp boiler but either one couldn't be obtained or they were just stalling the chief off. "Put in oil burners," said the plant superintendent, "that will give us the steam we need."

I wonder where he got his information. Maybe it was out of a bottle. Perhaps it might have been better if the superintendent had bought factory-made oil burners, but of course he had a better idea. They would make them. I don't know just what they intended them to be, inside mixing type or outside mixing.

These burners were made of pipe and fittings by taking a 1¼ in. tee and a piece of 1¼ in. pipe about 16 in. long, threaded in one end to screw it into the tee. A strip about 2 in. long was sawed off the other end, then it was flattened, turned up a little and a bushing put in the 1¼ in. tee looking directly through the 1¼ in. pipe. This bushing was to fit a ¼ in pipe. Then they put in a piece of ¼ in. pipe for the steam line; the 1¼ in. being used for the oil. This burner sure was a masterpiece. It wasn't much good at atomizing the oil but it sure blew it all over the furnace and made lots of black smoke.

These burners were installed directly over the doors in the center, front part of the Dutch Oven. The idea being for the flame to cover the sawdust and hog fuel pile in the Dutch Oven.

Usually there were big gobs of oil blown out of this burner to be lost in the fresh fuel pile. Of course, these burners helped somewhat as when the furnace was pretty near empty and the grates bare in places, the oil helped to keep the steam up.

The management was very much disappointed with the results obtained especially when the first of the month came and they got the bill from the oil company for the several hundred gallons of oil per day that was burned.

They never have been able to keep the dry kilns on. When the entire plant is in operation it is a case of compromise. When the steam drops to 140 psi the fireman closes the dry kiln valve and whenever it pops at 152 psi he opens the valve again. This valve gets plenty of use.

No doubt the management has given up the idea of making the power, as they are building more dry kilns so as to dry their lumber and are planning to purchase all of their electric power. Perhaps it will be cheaper at that.

PHILLIPS SCREWS

By Thomas Trail

At times Phillips head screws are difficult to remove due to the screwdriver socket becoming clogged and preventing the screwdriver getting a solid hold. A short length of spring steel wire, pointed on one end, with a loop bent on the other end makes a convenient tool to clean out the sockets.

Also, where the screw is difficult to start even after cleaning out the socket, a medium blow with a hammer on the handle of the screwdriver will usually loosen the screw.

Reconnecting Motors For Different Voltages

By C. C. HERMANN

MOST OF US KNOW that many things are done in an emergency which would not be done under normal circumstances. Therefore do not hesitate to make use of materials and items of power transmision at hand if production depends upon such decisions. Materials are still short, hard to get and the maintenance shops are expected to keep the wheels of industry turning.

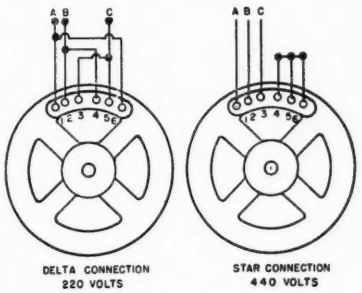


Fig. 1. Diagrams of delta and star connections

For example, motors are not generally convertible from 220 to 440 v unless of recent design and manufacture. In the latter case all leads are brought outside and a handy diagram placed on the frame to show how to reconnect them for one voltage or another. Figure 1 shows such a diagram and a few minutes study will suffice to indicate the voltage for which it is connected.

There are many motors in use however, which cannot be changed so easily, in fact, it is necessary to remove the end bells and expose the winding in order to make the change. When changing some of these older motors from delta conection to star and placing on 440-v service the winding will run warm and it is inadvisable to carry the load to rating. The reason for this is that the copper distribution may be right for one voltage but incorrect for the other. As an emergency however, the change can be made in the following manner.

Referring to Fig. 2 we have a 3-phase, 60-cycle 4-pole, 1800 rpm motor diagram connected two parallel star for operation on 220 v. This diagram may be changed to a series star connection as shown in Fig. 3. This change involves uncovering the various coil ends of the winding and reconnecting as shown. This operation can be performed in any electrical shop.

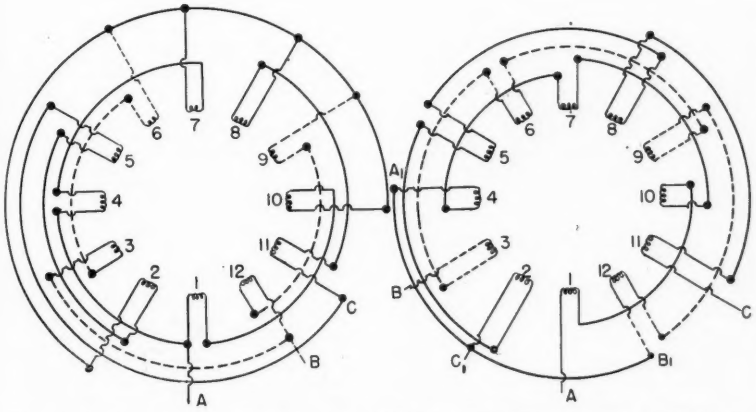


Fig. 2. (Left) A 3-phase, 60-cycle, 4-pole, 1800 rpm motor diagram connected parallel star. Fig. 3. (Right) Showing how connections in Fig. 2 may be changed to series star connection

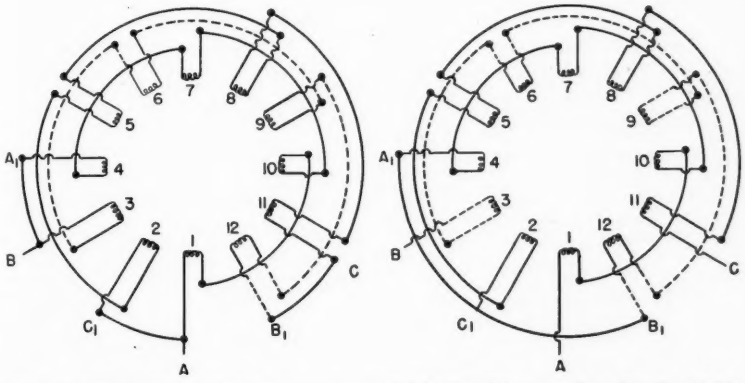


Fig. 4. (Left) Motor winding diagram connected delta for 220-v operation. Fig. 5. (Right) Showing how motor winding shown in Fig. 4 may be changed to 440-v operation

Another way a motor can be changed from 220 to 440-v operation is shown in Figs. 4 and 5. In Fig. 4 is shown the motor winding diagram connected delta for 220-v operation. To change this to 440-v involves the cutting of leads A1 from phase B, B1 from phase C and C1 from phase A. In the star connection these leads are tied together.

It is first advisable to locate the pole group from which the leads enumerated in the preceding paragraph should come before breaking any connections so that the wrong leads are not taken. Note that A lead should come from group 1, the B lead from group 3 and the C lead from group 11. Also note that A1 lead comes from group 4, B1 lead from group 12 and C1 lead from group 2. Of course A1, B1, and C1 leads are the ones to be tied together after which all bare wires are properly insulated, the joints soldered and the tails laid down and tied in to the winding securely to avoid any possibility of injury and consequent short circuiting when the motor is placed in service. The completed stator should be given a good coat of insulating varnish after which it should, when dried, test infinity to ground by use of the megger.

Motors of old manufacture will show lowered efficiency, lower power factor and run warmer than would ordinarily be expected and the expedient should only be practiced in cases of necessity for short duration.

POWERFUL ELECTRO-MAGNET AIDS RESEARCH

AN ELECTRO-MAGNET so powerful that the operator must stay at the controls four yards away when it is at peak operation in order to avoid having his pockets picked has been developed by Dr. J. E. Goldman of the Westinghouse Research Laboratories. It is an oil-cooled, 1½ t, iron-core, electro-magnet wound with 6000 turns of square copper wired and tipped with a special magnetic alloy.

The magnet, 5 ft long and 2½ ft high, has adjustable poles so that specimens from 1½ to 12 in. may be attracted and is capable of exerting a concentrated 4000 lb pull . . . a force strong enough to make possible new studies in magnetism.

One secret of the high magnetism produced is the special alloy tips. This alloy was developed by the Westinghouse Research Laboratories to give more magnetic energy than ordinary iron.

The variation in the gap between poles is accomplished by the use of adjustable tapered pole pieces. This feature adds immensely to the versatility of the magnet.

Maintenance of Industrial Electronic Equipment -IV

Relays and their functions . . . Types of relay contacts . . . Methods of cleaning . . . Methods of removing relays . . . Inspection of relays and typical faults . . . Requirements of a normal relay . . . Materials necessary for proper maintenance . . . Adjustment of relays

By WESTINGHOUSE ELECTRONICS COMMITTEE

IN ELECTRONIC apparatus, relays are used for the following functions:

1. As contactor relays to close power circuits. Their contacts are designed to carry large amounts of current.
2. As interlock relays to associate two different components or circuits in such a way that one will not operate unless certain conditions are fulfilled by the other.
3. As overload or underload relays to operate when the current or voltage in the circuit exceeds or drops below the predetermined value. They are generally used to protect the equipment.
4. As time delay relays to protect equipment. In general, this type of relay can be adjusted to operate after a period of a few seconds, or action can be delayed as long as 50 minutes. The time delay relay is usually used to allow a certain component to heat up before other potentials or components are turned on.
5. Telephone type relays used in high speed sequence circuits and time delay circuits. Adjustments and cleaning of most relays of this type should not be attempted by the maintenance man unless the adjusting tools and instructions recommended by the manufacturer are available. It is usually better to stock spare relays and return defective relays to the factory.
6. Special applications such as, when contact galvanometers are used to measure and control various things like temperature, carbon monoxide gas, or many other applications.

Relay contacts are usually of two kinds—hard surface or soft surface types. Hard surface contacts are made of various alloys. The soft surface contacts are of two kinds: Solid silver and silver-plated. Knowledge of the kind of material used in the contacts is important. Improper cleaning of silver plated contacts will soon remove the plating. The care of solid silver contacts deserves special attention as they are made of soft metal which will wear away at an excessive rate if carelessly cleaned.

Relay contacts are of various shapes, depending upon their size and application. In some instances both contacts are flat; while in other cases, one contact is convex and its mate is flat. The original shape of a contact must be retained during cleaning. If burning or pitting has distorted the contact so that it must be reshaped, the original shape must be restored. It is essential that maintenance men familiarize themselves with all details of relays by examining them while

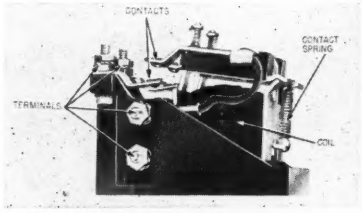


Fig. 7. This photograph shows some of the parts of a typical relay

they are in good condition. In this way they will be prepared to do their work well.

Relays enclosed in glass, bakelite or metal cases require the removal of the cover for maintenance. Some relays are not covered but must be partially disassembled in order to inspect contacts and completely disassembled in order to clean the contacts. Some relays can be inspected and cleaned without being removed from their mountings or taken apart. Although specific instructions for removing relays are given under the individual maintenance items in the instruction book supplied with the apparatus, a few details apply to all relays and are presented here for general guidance. Before removing a relay, take these steps:

Removing Relays

1. Examine the base of the relay to determine the location of the mounting screws. If possible, examine the other side of the panel and determine how the screws are fastened in place. Panels, covers or other parts often must be removed prior to the removal of the relay. Determine what must be done before attempting to remove it. This will save time and prevent damage to equipment.
2. Attach a tag to each relay terminal, with a number or letter on it; and attach a tag with the same identification mark to the associated connecting lead.
3. Remove each lead from its terminal and bend it carefully out of the way. When the leads are reconnected, match terminals and leads that have corresponding numbers or letters.

Inspecting Relays

Inspect the relay to detect abnormal conditions. If the contacts are not readily accessible, they should be inspected with the aid of a flashlight and a mirror. The mechanical action of the relays should be checked to make certain that when moving and stationary contacts come together they make positive contact and are directly in line with each other. The contacts must have the required "wipe" and "gap" for the particular relay. If an A.C. relay is excessively noisy, it is due to one of two reasons. First, the armature may not make a mechanically perfect union. Since it is usually a ground fit, any attempt to file it may make it worse. This requires expert care or a new armature. The other cause is that the shading coil or short circuited copper winding embedded in the armature face has open circuited. A new coil or new armature is required. The armature or plunger mechanism should move freely, without binding or dragging. Do not damage or misalign the relay mechanism. A relay is considered normal if it meets all of the following requirements:

1. The assembly is free from dirt, dust and other foreign matter.
2. The contacts are not burned, pitted or corroded.
3. The contacts are lined up and correctly spaced.
4. The contact springs are in good condition.
5. The contact moving parts travel freely and function in a satisfactory manner. (The solenoids of plunger type relays must be free from obstruction.)
6. The connections to the relay are tight.
7. The wire insulation is not frayed or worn.
8. The relay assembly is securely mounted.
9. The coil shows no sign of overheating.
10. The relay is not abnormally noisy.

Tighten all loose connections and mounting screws, but do not apply enough force to damage the screw or break the parts it holds. Do not

start a screw with its threads crossed. If a screw does not turn easily, remove it and start over again.

Clean the exterior of the relay with a dry cloth. If it is very dirty, clean it with a cloth (or brush dipped in cleaning fluid) and wipe the surface with a dry cloth to remove the film left by the fluid. If connections are dirty and corroded, remove, clean and replace them carefully.

1. Dental Mirror, Non-magnifying.
2. Paint Brush.
3. Lint-free Cloth.
4. No. 0000 Sandpaper strip ¾" x 6".
5. Sandpaper on stick, see Fig. 11 for constructional details.
6. Burnishing Tool.
7. Fine-cut file.

Maintenance Relay Contacts

Hard alloy contacts will require the following maintenance: Clean dirty contacts by drawing a strip of thin, clean cloth or paper between them while they are held together.

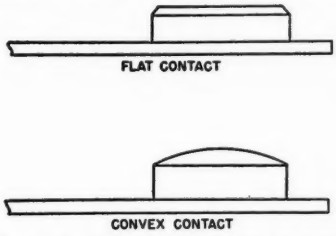


Fig. 8. Two types of contacts used in relays

In some cases, it may be necessary to moisten the cloth with cleaning fluid. Use a dry cloth or paper strip for polishing.

Clean corroded, burned or pitted contacts with a burnishing tool. This tool is not a file and is used on relays with extremely hard contacts. A contact should not be burnished unless it is found to be pitted or oxidized, and then not any more than is necessary to restore a smooth, clean surface. The original shape of the contact must be retained.

Solid silver contacts may be cleaned with a cloth or brush dipped in cleaning fluid. After cleaning, polish contacts with a dry cloth. The brown discoloration that is found on silver and silver-plated relay contacts is silver oxide, which is a good conductor. It should be left alone unless the contacts must be cleaned for some other reason. It may be removed with a cloth moistened in cleaning fluid.

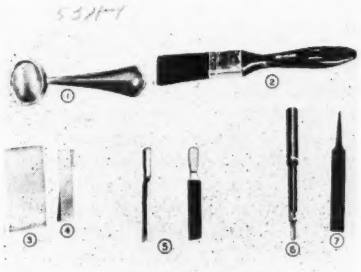


Fig. 9. Mirror, paint brush, cloth, sandpaper and other cleaning tools necessary for the proper cleaning of relays

Deeply pitted solid silver contacts will require shaping with a fine file or No. 0000 sandpaper.

In cleaning solid silver contacts, insert fine sandpaper between the contacts and draw it through them while the contacts are gently pressed together with the fingers, or, use sandpaper glued to a piece of wood as shown in Figure 11.

Note—After using sandpaper, small particles of abrasive may remain on the contact surfaces and must be removed to assure good contact.

When the corrosion has been removed, wipe the contacts with a clean cloth moistened with cleaning fluid. The final operation in cleaning should be polishing with a dry cloth, so as to make sure that all of the grains of sand from the sandpaper are removed from the contact surface. Make certain that the shape of the contacts has not been altered from the original.

Burned or pitted solid silver contacts should be resurfaced, if necessary, with No. 0000 sandpaper. The original shape of the contact should be retained. After a high polish has been obtained, wipe thoroughly with a clean cloth, using a cleaning fluid when required.

Very badly burned or pitted contacts should be replaced, if possible. If a replacement is not available use a fine-cut file to remove the pit. The original shape of the contact must be preserved. After filing, apply No. 0000 sandpaper, and finally a clean dry cloth.

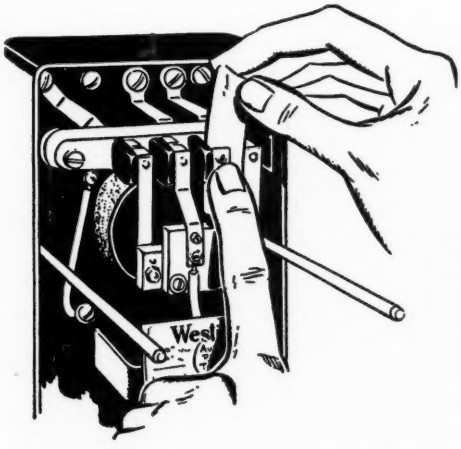
Silver-plated contacts are cleaned with a cloth or brush dipped in cleaning fluid. After being cleaned, the contacts are polished with a dry cloth. When corroded, contacts should be cleaned with sandpaper. This must be done very carefully so as not to remove too much of the silver plating. When the corrosion has been removed, polish the contacts with a clean, dry cloth, making certain that the shape of the contact has not been changed.

Silver-plated contacts that are badly burned or pitted should be replaced. If a replacement is not immediately available, the contacts may be dressed with sandpaper until the burned or pitted spots are removed. If you find that the sandpaper does not remove the burns or pits, then use a burnishing tool very carefully.

The use of a file on silver-plated contacts is recommended for only extreme emergencies.

Highly abrasive materials such as emery cloth, heavy sandpaper or carborundum paper should never be used for surfacing relay contacts as these materials will damage the contact surfaces.

Adjust contact arms to the correct positions if they have been moved during cleaning. Take care not to change the settings of adjustable relays. The correct settings and proper means of adjustment for the contactors and relays of a specific equipment will be found in the instruction book supplied with the equipment.



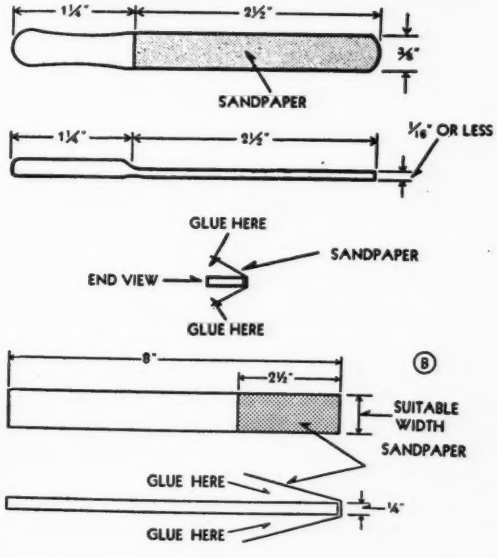


Fig. 10. Left. This drawing illustrates the proper method of cleaning relay contacts. Fig. 11—Right. Relay cleaning tools of this type make the job considerably simpler

The Meaning of Entropy and How to Use the Mollier Chart

What is Entropy? After millions of words have been written on this question it still remains a mystery to many practical engineers. It is one of the chief mental hazards in the profession. Why is this? Why is Entropy more difficult to understand than other quantities used in engineering work? Perhaps because it is an abstraction, because it requires a more intimate knowledge of the thermodynamics of fluids. Whatever the reason it is hard to understand and so any attempt at a new explanation is worth while. For this reason we take pleasure in presenting this article by Jacob Yavitch; he tells you what Entropy is and shows you how to use it. Also he explains the Mollier Diagram and shows how it is used in solving various types of steam problems

By JACOB YAVITCH Consulting Engineer, Philadelphia, Pa.

THE AMOUNT of work done by any fluid, such as steam in an engine cylinder, is equal to the product of the pressure multiplied by the volume swept by the piston.

$Wk = P \times V$ 1

where P = pressure, lb per sq ft

V = volume, ft^3 per lb

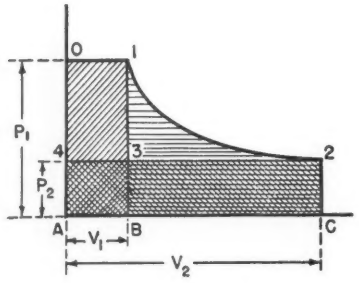
and WK = the work done in ft lb

The volume of course is equal to the area of the piston multiplied by the stroke.

This product can be plotted on a "Pee-Vee" diagram to get a picture of the way the pressure varies as well as the amount of the work done by the steam on the piston. The value of P is plotted along a vertical axis and that of V along a horizontal axis. The result is a work diagram is shown in Fig. 1.

When the operating engineer takes an indicator card on a steam engine or any other reciprocating engine he gets a work diagram. Read "The Sad Case of the Ailing Corliss" by W. S. White, POWER PLANT ENGINEERING, May 1946.

This work diagram or indicator card gives an indication of the work done by the working substance. This work is transmitted through the piston rod, connecting rod and crank pin to the crank shaft in the form of brake horse power.



PRESSURE - VOLUME DIAGRAM SHOWING WORKING AREA

Fig. 1. A pressure-volume diagram, showing the work area

Figure 1 shows a typical steam engine indicator card having no clearance. The horizontal scale (abscissa) represents volume and the vertical scale (ordinate) represents pressure. As it applies to the steam engine, this diagram may be interpreted as follows:

1. Area Ao1B is the work done in "pushing" the steam into the cylinder against the resistance of the piston.

The amount of this work is equal to the product P_1V_1.

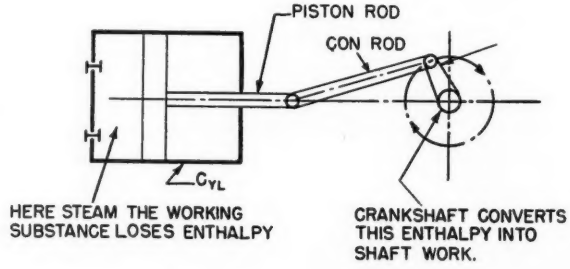


Fig. 2. Diagram of a steam engine

2. Area 12CB is the work done when the steam is expanding. If we assume that during this expansion heat has not been added nor lost (an imaginary ideal case), then the work has been accomplished at the expense of the internal energy of the steam. The amount of this work is equal to $(i_1 - i_2)$ in Btu. i_1 is the internal energy of the steam at the beginning and i_2 is the internal energy of the steam at the end of expansion.

3. A432C is the work lost in the heat energy discharged in the exhaust.

4. Area O1234 is the NET work done.

How can we express the above in one single expression for the amount of work that has been done, say by one pounds of steam, during this cycle of operations? The PV product is given in ft lb and i, the internal energy, in Btu.

Many years ago Joules established the equivalence of heat and work. He showed that 778 foot-pounds of work was equal to 1 Btu. Therefore, it is only necessary to multiply the product PV by $\frac{1}{778}$ to obtain the amount of heat in Btu. This factor $\frac{1}{778}$ is usually represented by the letter "A". Thus, the following expression gives the work done:

$WK = AP_1V_1 + (i_1 - i_2) - AP_2V_2$.. 2

$= (i_1 + AP_1V_1) - (i_2 + AP_2V_2)$ 2a

We know, however, from a simple thermodynamic theory, that the sum of the internal energy of a fluid and the APV product is equal to the "enthalpy" of a fluid in motion. Denoting enthalpy by h, we have

$WK = h_1 - h_2 = \Delta h$ in Btu 3

where h_1 is the specific enthalpy in Btu per pound at the beginning of the expansion

and h_2 Ditto at the exhaust

The difference in enthalpies Δ h, pronounced delta h, under conditions of no heat transfer to and from the working substance during the engine cycle is known as the "available energy." This is a measure of the maximum work that may be obtained from a fluid (such as steam) during expansion.

When a fluid (steam, gas, or air) is doing work, its enthalpy drops. This is shown in Fig. 2. If work is done on the fluid as by compressing air, its enthalpy is increased. The increase in enthalpy, Δ h, is a measure of the minimum work that must be expended upon the fluid to force it from one container to another at higher pressure.

When steam is expanding in an engine or turbine without the addition or subtraction of heat the expansion is known as "adiabatic" expansion. Similarly there may be an "adiabatic" compression.

The value of Δ h during an adiabatic expansion in a recpirocating engine represents the energy that could be delivered to the piston.

In the case of a turbine, Δ h is the energy that could be delivered to the steam to increase its velocity while passing through the nozzle.

When the operating engineer in charge of a steam engine wishes to know the amount of work the steam is doing in the cylinder, he can take an indicator card. What should the engineer do that attends a turbine? He cannot take an indicator card.

But heat and work are equivalent. WORK AND HEAT ENERGY GO HAND IN HAND. For every work diagram there exists an equivalent heat diagram. Just as the work diagram consists of two items, pressure and volume, so does the heat diagram. And what are they? One evidently is "temperature." And we must have another property of the substance.

Assume that we took a pound of

water at freezing temperature, 32 F, and added heat until the temperature became 212 F.

We have added 180 Btu or 180 × 778 = 140,040 ft-lb of work. This can be shown on a diagram in the form of a rectangle,. Fig 3a with p^a = 100 psia and a volume V_a = 9.72 cu ft.

Let us now construct a heat diagram for this case. And let us choose two coordinates. Along one we will lay off Absolute temperatures, and along the other values of another property of the water being heated. This property we shall call **ENTROPY.**

The amount of heat added in the previous example we shall designate by the letter q; the absolute temperature by T; and entropy by s. Then

$q = T \times s$ 4

$s = q \div T$ 4a

where, q = heat, Btu per pound

T = Abs. temp., t + 460

s = entropy, Btu per pound per deg F.

In Fig. 3 the temperature is increasing almost along a straight line, O1, shown dotted. The entropy is constantly increasing. The area, Oa1 is nearly equal to one half of the rectangle, Oa12. Now if we wish to find the entropy of water at 212 F, we need only to substitute the known values of q and T in equation 4a. The amount of heat added, q, is 180 Btu. The total absolute temperature, T = 460 + 32 = 492. This is the temperature at the beginning of heating the water. The final temperature, for our purpose, is 492 + 90 = 582 deg F abs.

Thus the entropy of the saturated liquid s_f, is

$$s_f = \frac{180}{582} = .031 \text{ Btu/lb/deg F}$$

Entropy can be defined as that property of a substance, which value multiplied by absolute temperature gives the amount of heat added during a definite process.

Let us further assume that we took the same pound water at the temperature of 212 F and kept adding heat. Let this temperature be the saturation temperature, i.e., the water is ready to start boiling. From now on while heat is added, the temperature does not change—it stays constant. All the heat added goes in changing the physical state of the water. This will go on until all the water is vaporized. It is now known as saturated, dry steam. The amount of heat added during this constant pressure and constant temperature process of vaporization equals to 970 Btu. In the illustration (Fig. 3a) it appears as a rectangle. Using formula 4, we have,

$$970 = T \times s$$
$$= (460 + 212) \times s$$
$$= 672 \times s$$

Or the entropy of vaporization, s_{fg}, equals to 970 ÷ 672 = 1.444 Btu per pound per deg F. The entropy of dry saturated steam, s_g, at the particular conditions is equal to the entropy of saturated liquid, s_f, plus the entropy of vaporization, s_{fg}, or

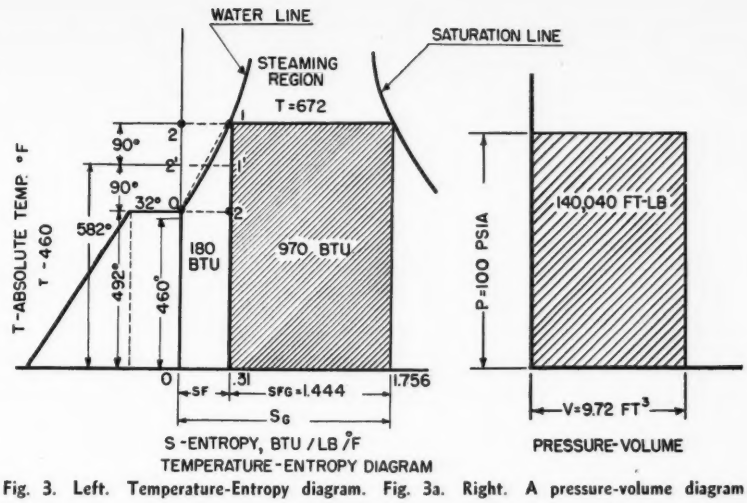


Fig. 3. Left. Temperature-Entropy diagram. Fig. 3a. Right. A pressure-volume diagram

$s_g = s_f + s_{fg}$

$= .312 + 1.444 = 1.756$ Btu/lb/deg F

Just as the work involves a change in volume so does heat involve a change in entropy. Work graphically is a pressure-volume diagram. Heat graphically is a temperature-entropy diagram. The connecting link between them is Joules constant, J = 778 or A = 1/778.

Figure 4 shows the work diagram and its equivalent heat diagram for a Diesel Engine. The arrows point in either direction to impress the equivalence of heat and work. Again, note carefully the coordinates, namely, pressure-volume and temperature-entropy.

A process during which the entropy is left unchanged is known as an "isentropic." An adiabatic process means no heat gain or loss, but does involve a change in entropy. An isentropic process means no heat gain or loss and NO CHANGE IN ENTROPY.

This is very important as we begin to unravel the "complexities" of the Mollier chart.

As we look in steam tables, we notice the following columns:

a. Pressure, psia — p
b. Temperature, deg F — *t*
s. Specific volume, cu ft per lb — $\overline{V}$
d. Internal energy, Btu per lb — i
e. Enthalpy, Btu per lb — h
f. Entropy, Btu per lb per deg F — s

Pressure is given as gage or absolute. Absolute presure equals gage pressure plus atmospheric, or

$$p_a = p_g + 14.7$$

Absolute temperature, T = t + 460 deg F.

By specific volume, enthalpy, entropy, internal energy, etc., is meant the numerical value per pound of substance.

The pressure-volume and temperature entropy diagrams will always be of utmost importance in the analysis of Power-Plant problems. But for the purpose of obtaining simultaneous values of the six important characteristics of a vapor in any definite state, the Mollier chart is more suitable.

In 1904 Dr. R. Mollier published charts that have been of great service in solving problems involving steam. The chart as shown in Fig. 5 consists of two coordinates. Along the vertical are plotted the values of specific enthalpies and along the horizontal values of specific entropies. On the same chart are plotted lines of constant pressure. temperature, per cent moisture, and degrees superheat.

Below the "Saturated Vapor Line" is the wet or "steaming" region. In this region, the lines of constant presure coincide with the lines of constant temperature. Above the "Saturated Vapor Line" is the Superheat region. In this region the lines of constant temperature are bent to the right and marked by dotted lines.

To demonstrate the use of the Mollier chart, let us answer a few questions and solve a few problems.

Question 1. What is the boiling or saturation temperature of water at atmospheric pressure.

Procedure: Note the lines "Constant Pressure, Lb per Sq In. Abs." and follow along the "Standard Atmosphere" line until it meets or intersects the "Saturated Vapor Line." This line appears on the chart as a heavy bold line. Note the dotted lines bent to the right of this line and marked 160, 200, 240. etc. Our point is just above the 200 line, but below the 240, by judgment or interpolation the saturation temperature is found to be 212. The exact figure will depend on the size of chart in one's possession. The larger the chart, the more lines are given, that is instead of giving the 200 or 240 there is another in between of 220. These figures are given in degrees F.

Question 2. Given the saturation temperature of steam, 320 F, it is required to find the saturation pressure.

Procedure: Find the temperature line marked 320 and follow along this line to meet the Saturation Line. At this point find which Constant Pressure

Modified and greatly reduced from KEENAN'S STEAM TABLES and MOLLIER DIAGRAM published by A.S.M.E. in 1930.

Absolute pressure, lb. per sq. in.	Saturation temperature, deg. fahr.	Absolute pressure, lb. per sq. in.	Saturation temperature, deg. fahr.	Absolute pressure, lb. per sq. in.	Saturation temperature, deg. fahr.
0.0887	32.0	55	267.1	800	518.2
0.2	53.1	60	292.7	850	525.2
0.4	72.9	70	302.9	900	532.0
0.6	85.2	80	312.0	950	538.4
0.8	94.4	90	320.3	1000	544.6
1.0	101.8	100	327.8	1100	556.3
2	126.1	110	334.8	1200	567.1
3	141.5	120	341.3	1300	577.3
4	153.0	130	347.3	1400	587.0
5	162.3	140	353.0	1500	596.1
6	170.1	150	358.4	1600	604.7
7	176.9	160	363.6	1700	613.0
8	182.9	180	373.1	1800	620.9
9	188.3	200	381.8	1900	628.4
10	193.2	220	389.9	2000	635.6
12	202.0	240	397.4	2100	642.6
14	209.6	260	404.4	2200	649.2
16	216.3	280	411.1	2300	655.7
18	222.4	300	417.3	2400	661.9
20	228.0	350	431.7	2500	668.0
22	233.1	400	444.6	2600	673.8
24	237.8	450	456.3	2700	679.5
26	242.3	500	467.0	2800	684.9
28	246.4	550	476.9	2900	690.2
30	250.3	600	486.2	3000	695.2
35	259.3	650	494.9	3100	700.2
40	267.2	700	503.0	3200	704.9
45	274.5	750	510.8	3226	706.1
50	281.0	...	...	...	...

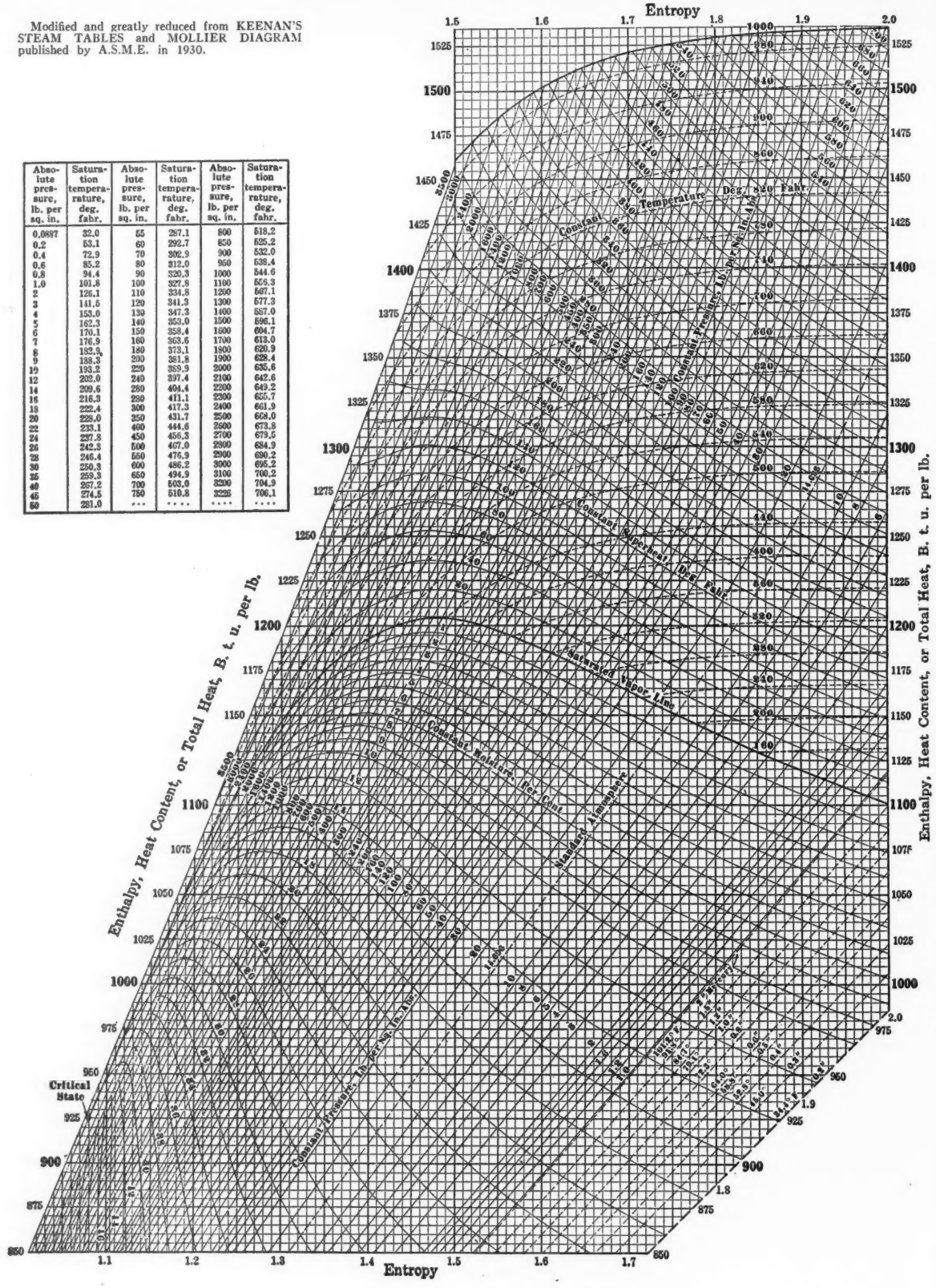


Fig. 5. Mollier Chart of the Properties of Steam

line passes. You will note that it is the 90 psia line. Thus the saturation pressure is 90, or if water is subjected to a pressure of 90 psia it must be heated to 320 F before it boils. For every pressure there is a distinct and definite saturation temperature.

This fact must be emphasized. To use the Mollier chart for finding the values for the different properties of steam, we must know two of them. One is given or must be gotten by an instrument and the other can be gotten by assumption.

3. Question 3. Given the pressure at throttle of a steam engine to be 15.3 psig. The steam is dry and saturated.

It is required to find:

a. Enthalpy
b. Entropy
c. Temperature.

Procedure: We must locate the point. This can be done from the given data. The absolute pressure is 15.3 + 14.7 = 30 psia. Along the "Constant Pressure" lines locate the one marked 30. Follow this line until it intersects the "Saturated Vapor Line." Our point is now located. We need the first two conditions to locate the point and now we can find the values of a, b, and c.

To find enthalpy. Use a pin to prick the paper where the point was found. Now turn to the left and note along horizontal bold lines numbers 1100, 1150, 1200 etc. These numbers designate the values of enthalpies, Btu per pound, specific enthalpies. Our point lies between the 1150 and the 1175 lines. Between these two lines you will find five light lines each evidently representing (1175 — 1150) ÷ 5 = 5 Btu. Our point is located just before the third light line, therefore we read 1150 + (3 × 5) = 1165. Remember it is slightly less, or the exact value is 1164 Btu per lb.

To find entropy. Turn your eyes down along a vertical line that crosses our point. A bold line marked 1.7 intersects our point. The value of entropy of dry saturated steam at 30 psia pressure is 1.7 Btu per pound per deg F.

To find the temperature of the steam: In the question, it is given that the steam is dry and saturated, hence the temperature we look for is the saturation temperature of steam at 30 psia pressure. Find the dotted temperature lines between which our point is located. The line below is marked 240 F and the other, above, 280 F. Our point is about one-fourth the distance between the two lines. Hence the temperature of the steam is 250 F.

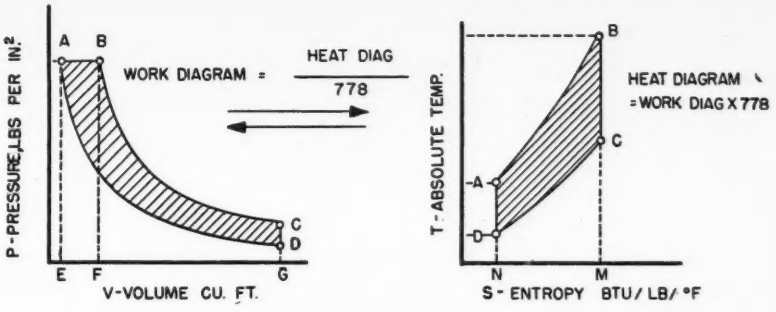
Problem 1.

Let us assume that this prime mover, steam engine or turbine, is exhausting into a condenser that maintains a pressure of 1 psia. We now want to find all the properties of the exhaust steam with the help of the Mollier chart.

The properties of steam that we want to find are:

a. Enthalpy, h
b. Entropy, s
c. Temperature, t
d. Quality, X

We have stated already that to use the Mollier chart we must know two conditions of the steam. One we know, namely, the pressure. We must know one other value or condition so as to locate the intersection of two lines on the chart. The intersection of the two lines will give us a point. Then by going to the right or left, up or down we can find all the necessary data.



$$\frac{\text{WORK}}{778} = \text{HEAT} = \text{ENTROPY} \times \text{ABS. TEMP.}$$

Fig. 4. Work diagram and its equivalent heat diagram

The conditions of the steam at the throttle we have located in Question 3. The point on the chart is on the saturation line and at the place where the 1.7 entropy line intersects it.

This assumption is made: the expansion of the steam through the engine is an "isentropic" process, i.e., no change in entropy. Hence to locate the point, follow the 1.7 entropy line down until it intersects the 1 psia "Constant Pressure Line." Our point is located.

Remember an isentropic process on the temperature-entropy or on the enthalpy-entropy (Mollier chart) diagram is represented as a vertical line. See line ad or bc Fig. 4.

a. To find enthalpy. Keep the point and turn to the right or left, suit yourself, along a horizontal line and read 950 Btu.

Delta h is equal to 1164 — 950 = 214 Btu

b. To find entropy. This by assumption is found to be 1.7.

c. To find, x, the quality of the steam. Follow the lines of "Constant Moisture, per cent" and note which of these lines intersects our point. The line marked 15 per cent intersects, this means that the steam contains 15 per cent moisture. And the quality is the difference between 100 and 15, or x = 85 per cent.

d. To find the temperature of the steam. We now know that the steam is wet. The temperature of the steam is the same as the saturation of 1 psia pressure. The method of finding the saturation temperature of a definite pressure has been covered in Question 1.

Problem 2.

Given the total temperature of steam, 360 F and the pressure 50 psia.

It is required to find the conditions of the steam. Is the steam wet, dry or superheated. Also what is the superheat or quality as the case may be.

Solution. Locate the 360 F temperature line. It is bent to the right and is located above the Saturation Line. Find the 50 psia Constant Pressure Line and follow this line until it intersects the found temperature line. Now notice in the superheated region lines marked Constant Superheat Deg F. These lines follow from left to right. Our 360 temperature line and the 50 psia line intersected in the superheat region, which indicates that the steam is superheated. The superheat line marked 80 F crosses our point. Hence the number of degrees of superheat is 80.

What is the saturation temperature of steam at 50 psia?

360 — 80 = 280 F

Problem 3.

Given steam of 80 F and pressure 50 psia.

Find the total temperature of the steam?

Work this one out yourself. You need the practice.

OLD PROCESS SOLVES GAS TURBINE PROBLEM

MASS PRODUCTION of precision-cast blades for aviation gas turbines is now possible by using a 16th century wax model process originated by the Florentine sculptor, Benvenuto Cellini. A precision-casting laboratory set up by the Westinghouse Electric Corp. is producing metal turbine blades by this process.

Turbine blades were previously stamped out of red-hot metal by a heavy forge. Development of a more durable metal alloy made the blades so hard that the drop forge dies suffered excessive wear and frequently broke. Using the wax model process, blades are now turned out as precisely as if each had been machined on a lathe. The only machining now required is in making a master pattern of the turbine blade desired. A metal die is made from the master pattern and molten wax injected into it to produce a wax model. Twelve of these models are mounted on a wax base and covered with a metal flask into which is poured a mixture of clay and silica. When the cement hardens, the flasks are put into an oven where the wax melts and burns away, leaving cavities in the cement into which molten metal will be poured to form the finished turbine blades.

WATER TEST CHEMISTRY HELPS YOU OPERATE SOFTENER BETTER—II

By URBAN C. FLEMING, JR.

Chemist, Gas & Electric Department, City of Holyoke, Mass.

This is a continuation of the explanation given in Part I, November 1946 issue of just what happens in the sample while you are running a feedwater test and why that is important in operating a lime-soda softener. After showing in Part I the chemical reactions involved in the various alkalinity tests, the author shows here how to calculate the amount of carbonate and hydroxide alkalinity in the sample and how much of the carbonate alkalinity is due to excess soda ash or to calcium carbonate hardness. . . . See complete directions for making water tests by Mr. Fleming, June 1945 issue, also step-by-step illustrated directions by E. O. Davis, October, 1945 issue.

Correction:—In the third line from the end of the sub-title of Part I of this article in the November issue, the unfortunate omission of the word "not," after it had been marked in on the proof, completely reversed the meaning. The sentence should have read "The present article, however, gives you information . . . that you will NOT find elsewhere." This whole discussion of the test reactions is definitely an original contribution to the feedwater testing data for power engineers. Neither the author nor ourselves have been able to find it in textbooks and manuals ordinarily available to power engineers, although it is fundamental knowledge to chemists. Therefore the author prepared it especially for engineers.

WITH AN understanding of the chemical reactions involved in these alkalinity tests we may now proceed to the method for calculating the amount of carbonate and hydroxide alkalinity in the water sample being tested. I shall mention again that in the phenolphthalein alkalinity test the total hydroxide alkalinity and one half the carbonate alkalinity is neutralized; in the methyl orange test the total hydroxide and the total carbonate alkalinity is neutralized. Expressing these facts as formulas we have

P = Number of cc of N/50 sulfuric acid required for phenolphthalein alkalinity test.

MO = Number of cc of N/50 sulfuric acid required for methyl orange alkalinity test.

OH = cc of N/50 sulfuric acid required to neutralize hydroxide alkalinity.

CO_3 = cc of N/50 sulfuric acid required to neutralize carbonate alkalinity.

$\frac{CO_3}{2}$ = cc of N/50 sulfuric acid required to half neutralize carbonate alkalinity or to convert CO_3 to HCO_3.

(1) $P = OH + \frac{CO_3}{2}$

(2) $MO = OH + CO_2$ or

(3) $OH = P - \frac{CO_3}{2}$

Substituting (3) in (2) we have

$$MO = (P - \frac{CO_2}{2}) + CO_3 =$$

$$P + \frac{CO_3}{2}$$

$\frac{CO_2}{2} = MO - P$ Therefore

$CO_3 = 2\,(MO - P)$

Therefore, the number of cc of acid required to neutralize the carbonate alkalinity is equal to 2 (MO reading — P reading). The carbonate concentration in parts per millions expressed as $CaCO_3$ is equal to the above value, 2(MO — P), multiplied by 20 when a 50 cc sample of water is used in the tests.

To determine the amount of acid used to convert the hydroxide ions to water we proceed as follows:

(1) $P = OH + \frac{CO_3}{2}$

or

(2) $CO_3 = 2(P - OH)$

also

(3) $MO = OH + CO_3$

Now substituting (2) in (3) we find that

$MO = OH + 2(P - OH)$

$= 2P - OH$

$MO = 2P - OH$ and $OH = 2P - MO$

The number of cc of acid required to neutralize the hydroxide alkalinity is equal to 2 times the phenolphthalein reading minus the methyl orange reading. The hydroxide concentration of the water sample expressed in parts per million of $CaCO_3$ is equal to 2P — MO multiplied by 20 when a 50 cc sample of water is used in the alkalinity tests.

The carbonate alkalinity in the water is due to carbonate ions from the excess soda ash and carbonate ions due to calcium carbonate in solution. It is now necessary to determine how much of the carbonate alkalinity is provided by each of the above sources.

In order to determine the portion of the total carbonate alkalinity which is due to soluble calcium carbonate a hardness test must be carried out on a sample of the effluent from the lime soda softener. The amount of soap solution used in the test is a measure of the calcium hardness of the water, which is all due to calcium carbonate, if an excess of soda ash has been fed to the softener. It is likewise a measure of the carbonate alkalinity due to calcium carbonate as distinguished from the carbonate alkalinity due to excess soda ash.

The number of cubic centimeters of soap solution used in the hardness test is multiplied by 20 to give the hardness of the water expressed as parts per million of calcium carbonate. The number of cubic centimeters of soap solution used is also multiplied by 20 to give the carbonate alkalinity due to calcium carbonate expressed as parts per million of calcium carbonate.

Since the same factor (20) is used to convert the 2(MO — P) reading to parts per million of total carbonate alkalinity expressed as $CaCO_3$ as is used to convert the hardness reading (H) to parts per million of carbonate alkalinity due to calcium carbonate expressed as $CaCO_3$, the carbonate alkalinity which is due to excess soda ash may be determined as follows:

2(MO — P) — H = Number of cc corresponding to carbonate alkalinity due to excess soda ash.

[2(MO — P) — H] × 20 = Parts per million of carbonate alkalinity due to excess soda ash expressed as $CaCO_3$.

For instance let us assume that the following readings were obtained on tests of the effluent from a lime soda softener.

P reading = 2.8 cc

MO reading = 3.9 cc

H reading = 1.1 cc

2(MO — P) × 20 = Parts per million of total carbonate alkalinity expressed as $CaCO_3$.

2(3.9 — 2.8) × 20 = 44 Parts per million of total carbonate alkalinity expressed as $CaCO_3$.

H = 1.1 cc of carbonate alkalinity due to calcium carbonate.

H = 1.1 × 20 = 22 parts per million of carbonate alkalinity due to calcium carbonate expressed as $CaCO_3$.

The carbonate alkalinity due to excess soda ash is: 2(MO — P) — H = 2(3.9 — 2.8) — 1.1 = 1.1 cc

1.1 × 20 = 22 parts per million of carbonate alkalinity due to excess soda ash expressed as $CaCO_3$.

The proper limits for 2(MO — P) — H and for 2P — MO have been indicated elsewhere in this paper and should be adhered to closely in order that the lime soda softener may be operated most efficiently.

BEATING THE MATERIAL SHORTAGE

By C. C. Hermann

"LOOK BOSS," SAID BILL as he came into the office dragging his feet a little and looking down hearted and tired. "We might as well close up this dump and go hunting or something. There isn't a three inch pipe elbow of any type in stock and the stock room says they don't know when or where to expect some."

"No elbows in stock. Well now that is a calamity," said the boss as he rubbed his chin. He wasn't a man to give up easily and his employees knew all about his resourcefulness. Bill thought he had the boss stuck for once.

The boss looked up smiling. "Bill," he said. "I can see a three inch elbow right from where I am sitting."

Bill turned to look in the direction the boss indicated, "I don't see a thing except a few pieces of pipe on the pipe rack and some tools beyond," said Bill.

"That's right," said the boss. "Some three inch pipe and among the tools I see a welder."

"I get it," said Bill as his spirit came back. "You're thinking of making a fitting."

"Sure. Why not? We have welded a lot of pipe in this shop. I don't know why we can't make a three inch fitting. Suppose you go over there and get a piece of that pipe on the bench and the cutting torch hooked up. I'll be right over and we'll see what we can do."

Bill did as he was told and a few minutes later the boss came up to where he was working.

"I suppose we will just cut the pipe

at a 45 deg angle and weld the two pieces together," said Bill.

"Not on your life," said the boss. "You know what you would do by that kind of an elbow? You would be increasing the resistance about two hundred per cent over what it would be with a good commercial elbow. No, we don't want to do it that way. Neither do we want to make too many cuts and welds. We could cut any number of pieces at a determined angle and make a very long throat radius elbow but still there would be some turbulence in the fitting. So we will compromise and make the elbow with a throat radius of say two times the diameter. Then we will have a turbulence factor of about 9 D, that is, the elbow would have a resistance equal to a piece of straight pipe 9 times the diameter in length. Now the ordinary standard elbow has a turbulence factor of about 18 D so we are bettering commercial practice some. On the other hand our welded joint may result in raising the resistance some so we might say that our elbow would just about equal the commercial fitting."

"Now how many gores or pieces are we going to cut? We can make three, five or seven. Three gores would be too sharp and seven gores would be too much welding so we'll compromise on five pieces. Now we must turn through 90 deg so dividing this by 5 we have the included angle of each piece as 18 deg. We lay the work out like this," and the Boss drew some lines on a sheet of paper to illustrate. "We cut the pipe along a line of 18 deg to its axis first, thus giving us two pieces of pipe each with the proper angle cut. Now we cut three pieces each having an included angle of 18 deg to fill the elbow. To lay the work out we draw the throat arc with a radius of 7 in. Now locate the center line of each gore and cut a section of pipe which is 2¼ in. long on the throat side and 3⅜ in. long on the opposite or outside. Then tack these pieces together correctly and we have our elbow which will be just as good as a commercial elbow when we complete the welding operation."

"I see you are bound to retain your record for resourcefulness," said Bill as he went to work.

"And we won't have to shut down the plant," laughed the Boss as he strode back in the direction of his office.

LETTERS AND COMMENTS

POWER HOUSE ERRORS

By H. B. McDermid

DURING HIGH FLOODS some years ago, the public utility which furnished power for our large wood working factory was flooded out and of course, put temporarily out of business. The factory had a fairly complete power house which had never been entirely satisfactory, but which with a casual inspection, seemed usable. The boilers had been in constant service furnishing heat and process steam but the power generating equipment had been laid up about four years, beginning when the central station sales engineers had succeeded in landing the contract for power. The engine room equipment seemed to have suffered very little from the idle period, but all sorts of rumors were afloat concerning its history. Since no one knew the probable duration of the flood, we started the main engine, threw in the switches, and carried the load till the water went down and the central station was again able to take over.

No dependable person was about who intimately knew the story of the plant, yet since there were large quantities of wood waste to be burned, which in summer time kept the "pops" roaring all day long, it was decided to repair the main engine and go back to producing power again. The exhaust steam could be used about seven months of the year in heating the plant, and all the time in kiln drying the lumber manufactured. It was recognized that the 600-hp plant was dangerously near the border line of being too small to compete with central power, but it was thought that with the waste fuel available, the economic balance would be in favor of home production.

Local stories had it that the engineer in charge, had in the previous operation, formed the habit of letting his firemen start the main engine, while the engineer read his morning paper. One day the office manager noted that the head end cylinder head was loose and ordered an investigation which disclosed that six cylinder head bolts had been snapped and others stretched from the action of a slug of water. The bolts were replaced, but evidently the crank end head was not investigated at that time. Our check showed that doubtless the same water slug had slammed against the crank-end head, and since it could not get away by bursting its bolts, had suffered the damage of having a hole punched through the cylinder to the steam passages in the head, so that a very pronounced leak occurred any time the throttle was open. Anything like steam economy was impossible, and as it did not seem wise to risk a weld on such a job, a new head was ordered. Rumors had also been prevalent that this engine had broken a large number of crank pin connecting bolts, so while waiting for the new head to arrive, we decided to check the shaft for proper 90 deg alignment with the cylinder line. On the first trial, the foreman refused to believe his senses, having been raised in a day when decent work was still fashionable and when no incompetent man would be trusted to set up an engine of that size; but the second trial showed no better, and to make a long story short, the outboard bearing of that engine was ⅜ in. out of proper position. The bearing and direct-connected generator bases were heavily grouted in position (in the wrong place), so it was decided to reposition the hold down cap screw holes. Threaded cast-iron plugs were made and the holes tightly plugged with them, so the holes could be redrilled and tapped in their proper position. The crank pin was next checked to see what damage had been done to it by some years of running out of square, but no damage could be detected until it was properly keyed up and run for some hours. Then under full load, it overheated and ran out the babbit in some twelve hours running time. As the machine was to be at least full loaded, it was decided to take no chances, so the crank pin was re-turned in place and the bearing re-metalled in good shape. It was then "run in' 'and keyed up with care and never after gave trouble, though it ran for five years with considerable overload.

The equipment of this plant was sure a collection of mis-fits—two water tube marine boilers designed to operate at 200 lb pressure, and so when badly overloaded, this pressure had to be used on the boilers in order for their full load to be produced and transmitted through the steam nozzles. The main engine was built for 135 lb, but with the advice of the builders was run at 150 lb to make sure it had plenty of pressure to hold its overload. The auxiliary engine was built for 100 lb. As every unit in the system had to do all it was able, reducing valves and ample steam receivers had to be installed on each engine to allow them to do their work properly and still allow the overloaded boilers to get their full capacity through the relatively small steam nozzles and pipes to supply the engines with enough steam.

Three lessons are to be seen in this power house experience. One; never trust a strange mechanic's work when it is possible to check it, no matter how likely it appears that it should be right. This engine was put in by a big city consulting engineering firm's representative, and should have been expected to be right—but instead was about as wrong as one might find anywhere. Two; never trust an incompetent or lazy engineer, even if he works for no pay, he is too dangerous to have around a power plant. And third; never try to beat a central station with too small a plant; the cards are stacked against you and too much labor per unit of power will beat you out. Remember that an engineer can watch a 10,000 hp unit just as easily as he can a 600 hp one, and in case of the big one he has a lot more revenue out of which to get his salary. Had the above plant been half larger it could have beaten the central station or had it had a year round market for its exhaust steam that also would have helped. It could not win out, however, on its small volume, or on a seven month's market for exhaust steam.

ANALYSIS OF TURBINE CONDENSATE PAYS

IN THE PLANT I work in, the feedwater is chemically treated to a degree whereby the boiler water concentrations are kept in suspension and then skimmed off to a continuous blow down and discharged to the sewer. In order to maintain this chemical balance we analyze our feedwater daily.

As most of our water returns from the process steam in the mill, we keep a constant watch over all returns. One of the turbines I operate is a condensing bleeder type machine and the water we use is pumped from a tidal creek. We have provided a condensate sampling line on the turbo condensate discharge and make daily tests of this water also. The average condensate in our plant shows about 4 to 5 ppm chloride content. Should the daily test show more than the usual 5 ppm chloride, we then at the next shut down test out the condenser for a leaky tube, and make necessary repairs. Several months ago, the condensate chlorides went up to about 18 ppm. The first week end we shut down we tested out the condenser tubes for leaks. After making the test we found that all the tube ends were dry and no leaks showed up. After starting up and making the daily tests of condensate the chlorides continued to remain high. After making a thorough study of this condition we arrived at the conclusion that the turbine gland water which is "well" water was being pulled into the condenser at the exhaust end. The turbine is constantly operating at a 28 in. vacuum. In order to eliminate this condition we were forced to repipe the exhaust end gland and use treated water from the water softener.

After performing this change our chloride content dropped down to the normal 5 ppm content.

In the meantime, we were still using the well water to the oil cooler and the steam end gland. This arrangement seemed to be working out very well, until this summer. We shut down for 2 weeks to make our usual annual inspections and repair work. The turbine was opened up for inspection and we found that the gland runner on the exhaust end was nice and clean while the gland runner at the steam end was badly clogged up with scale which had to be chipped off.

After deliberating with the service engineer regarding this matter, we came to a conclusion that it was the treated water that kept the exhaust gland clean. We have now made arrangements to use treated water at the steam end also.

We expect to repipe the treated water to the steam end and just use the hard well water in the oil cooler. The reason for this decision in using the well water in the cooler is because the well water is about 20 F cooler than the treated water ,and will keep our oil temperature down.

The gland water discharge is not being wasted as we have piped the water leaving the glands into the house pump storage tank. This water gets pumped back into the mill supply for processing and it does not cost us much for treated water.

Ridgefield, N. J. JOHN F. SLAVINSKY

ENGINEER'S GOLD MINE

THIS LETTER is written in reply to the article "Engineer's Gold Mine" by H. E. Brooks (September issue, POWER PLANT ENGINEERING, page 100). It is certainly a good article and if half of the readers will follow the advice given they also will begin to accumulate a gold mine. This is certainly something for the operating plant engineer to follow through with, not that many don't do it, but it's a good start for the engineers that don't have a library.

Many of the old chiefs are practical men, but are wise enough to have the knowledge put away so as to be able to refer to it whenever possible. The chief that Mr. Brooks tells about must have been a grand guy to know in his day. There are few chiefs (as well as many of the operators) who will admit they don't know. Many times you will hear some in this field of endeavor say, "Share your knowledge" but they won't honestly follow this out.

Yours truly has been fortunate to work with a few "old timers" especially when starting in this engineering field and they always tried to help me, especially if they saw I was trying to help myself. I've noticed that those chief engineers who are respected and honored for their knowledge are always the ones to encourage the men under them to get more knowledge. One of the chiefs many years ago had this to say for knowledge, "A hold-up man can take everything you have on you including your pants, but the knowledge that you put in your mind can't be taken away." Knowledge is needed in every field at all times and too much can never be acquired.

Reading technical magazines is a good habit . . . to save the information gained is a better habit. I have been building up a "mine." At present it still is far from a "gold mine" but in later years it may become one. After reading H.E.B.'s article I'm more convinced than ever that a larger library of clippings would be fine. What I'd like to see more often (I have only once come face to face with it) is the acquiring of magazines by the many concerns having engineers to operate their plants. I believe the average chief engineer can sell his company the idea to subscribe to the leading magazines and have them outside the chief's office or at some convenient point so that all the operating men get a chance to see them. Most men in the power plant will read, even on watch, if the watch or shift hasn't too much work. Also many other operators would read on their lunch period, so between these two, magazines properly placed will be seen and read.

In one large department store in this city the chief engineer has on a table outside of his office at least ten leading magazines and all refer to the equipment in his power plant in one way or another. He even makes notes and has these pinned up on the bulletin boards so that the operating personnel will read some particular article that he has outlined. The magazine is sent down to the engineer in charge with notes for the boiler, engine and refrigeration crews. The chief comes around from time to time and might stop and ask any man of his crew what he thinks of a particular article. The one to be advanced is the operator who is on his toes at all times.

Hoping to hear from H. E. Brooks again in the near future.

WILLIAM T. MULLEN

FURTHER COMMENTS ON PURGING REFRIGERATION SYSTEMS

WHEN PURGING non-condensable gases from a refrigeration system, a bottle is preferable over a bucket because the procedure is better watched through glass and because the small neck of the bottle keeps the ammonia laden water from splashing out. Splashing out would turn the ammonia loose in an enclosed room, as a rule, and defeat the purpose of using water as an ammonia absorbent.

The accident Mr. Lindberg describes on page 101 of the August issue was caused, not by use of the bottle, but by careless opening of the outlet stop valve and thoughtless missetting of the adjusting nut, which should be at zero when the outlet valve is opened. Precaution in opening the outlet valve is essential, however. In manual purging a too sudden opening of the purge valve may blow most of the water out of a large bucket. Equal precaution should be taken when opening the outlet of an automatic purge—as that used in manual purging.

All too many experienced engineers open or close a valve too quickly. In refrigeration work this is bad enough in intersystem connections. To atmosphere, it is inexcusable. When blowing down oil from a trap one of our operators once blew a half bucket of oil over himself and half the compressor room. The cause was very easily determined. He opened the valve too quickly.

On another occasion a rookie service mechanic was manually purging a medium-sized commercial unit through the top connection of the crankcase oil gage glass. He was using a metal hose bent downward into a large wooden bucket filled with water. With care in the procedure, the set-up was all right.

But care, with a full knowledge of how vapors act under high pressure, was lacking. The mechanic opened the pumpout valve to permit the foul gases to enter the crankcase from the condenser. This was still fair practice since discharge pressure was not high.

Then he opened the cock too quickly.

In attempting to straighten out under pressure (the common principle of the bourdon tube, by the way), the hose whipped out of the tub and struck the mechanic a stinging blow acros the face. Ammonia-fouled non-condensable gases filled the room before a second mechanic, with greater knowledge of engineering principles, ran into the foul atmosphere to seize the hose and close the cock.

To recapitulate, when putting an automatic purge into service, ease the relief valve pressure by backing out the adjusting nut to zero. Then open the outlet valve—or any other ammonia valve—with caution.

Marissa, Illinois. GEORGE HOLMAN

Questions And Answers

Question No. 354

HOW MUCH ROOM BETWEEN FLOOR AND COAL BUNKER?

HOW MUCH ROOM is required between boiler room floor and under-side of coal bunker, in a plant where bunkers deliver coal to stokers?

In former days, this bunker clearance above the operating floor and also the installation of the usual swinging coal spouts, were usually governed by the space required for boiler tube removal. But with the newer types of boilers, where the tube removal space may not be required in front of the boiler but somewhere else, what then determines the design of bunkers, chutes, etc.?

Pittsburgh, Pa. R.L.S.

It would seem that three fundamental conditions govern the height of the bunker. The first of these, and probably the most important, is to get the bunker high enough so that the coal chutes leading from bunker to stoker will have sufficient angle so that coal will flow freely through them by gravity. The generally accepted data on this is that coal will flow in a chute pitched at 35 degrees when the coal is dry, but a slope of close to 45 degrees from the horizontal is necessary to prevent plugging when coal is damp or chilled. Of course, the nearer you can get the chutes to vertical the better from that point of view. Obviously the shape of the bunker and its capacity are also important factors. The most exhaustive study of this whole subject of the flow of coal from bunkers and chutes was given in an article Flow of Coal in Chutes by E. F. Wolf and H. L. van Hohenleiten in the July 1945 issue of POWER PLANT ENGINEERING, pages 93 to 95 and 100.

The second important factor that influences the height of the bunker is whether or not any equipment, such as a weighing device, must be interposed between the bunker and the stoker hopper. Other devices, however, are sometimes interposed between bunker and stoker hoppers, such as under-bunker conveyors to feed coal to stokers or pulverizers so located that coal cannot be fed to them by gravity. All the factors involved in the use of under-bunker conveyors are very well analyzed in an article Five Reasons for the Employment of Under Bunker Conveyors by A. J. Stock in the June 1946 issue, pages 80 to 82.

Another fundamental factor we have observed in some plants determines the height of the bunker. That is the way in which the coal is loaded into the bunker. You want to keep elevating equipment height at the minimum, to save power and material. We have seen a number of plants in which the boiler room was down on the side of a hill, and the coal cars came in on a track farther up the hill, so that, by running a trestle over the coal bunkers, the cars could be unloaded directly into the bunkers. In a case like this, the relative heights of track, coal bunker, weigh larry, under-bunker conveyors and stoker hoppers would have to be pretty well determined in advance, so you could be sure the coal would flow properly.

Other recent articles that should aid, published in POWER PLANT ENGINEERING are Coal and Ash Handling in the Small Plant, October, 1944, page 96. Don'ts for the Designer of Coal and Ash Handling Installations, December, 1943, page 71. Bins, Bunkers and Silos for Coal, May, 1946, page 90.—All by Wilbur G. Hudson. Coal Segregation in Boiler Plants by A. J. Stock, August, 1944, page 71.

Question No. 355

WHAT IS BEST METHOD OF PIPING TO HEATING COILS

THE VENTO COILS were top feed, bottom return. Since air is heavier than steam, the coils were vented at the bottom, letting the air "drop" through the coil.

The "double-tube" or "non-freeze" coils are bottom feed, bottom return. The air must be vented at both supply and return or the air will have to be pushed up through the coil.

To avoid this undesirable condition, would it be safe to use top-feed, bottom-return coils, vented at the bottom; or is there too great a danger of freeze-up? It is taken for granted that there is sufficient steam supply and that the coils are adequately drained and vented.

Chicago, Ill. L.F.C.

Editor's Note—Concerning the phrase "since air is heavier than steam" see discussion under Question No. 346, page 108, October 1946 issue.

Answer No. 342

HOW FAST DOES A WIRE OR ROD CONDUCT HEAT

Calculations by Lipley

FIRST, IT MUST be made clear that, under the conditions of perfect insulation specified, the cold end of the rod will theoretically never reach 300 F. For heat to be transmitted, there must be a temperature differential and under the given conditions, this differential would approach 0 as the temperature approached 300. With that understanding, the following is submitted.

Of course, the rate of heat transfer by conduction will vary with the material. Arbitrarily let us assume it is copper in the form of a rod 20 ft long as in Fig. 1. As will be seen, its cross-sectional area has no effect on the final solution. Let this area be A sq ft.

The initial temperature of the rod is 70 F and I assumed that no heat was lost from the rod. The volume of the rod is

$$\text{Vol. in cu ft} = 20\ A$$

The density of copper is approximately 556 lb per cu ft. Therefore

$$\text{Wt in lb} = 20\ A \times 556 = 11{,}120\ A$$

Now Fourier's Law states that the rate of heat transfer is directly proportional to the temperature drop

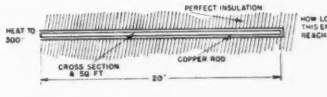


Fig. 1. To calculate heat transfer rate R. C. Lepley assumed a copper rod of A sq ft cross-section, 20 ft long, perfect insulation

and to the area, and inversely proportional to the thickness (length in this case) or

$$\text{Rate} = \frac{h\ A\ \Delta t}{L} \text{ Btu per hr}$$

where h = heat transfer coefficient in Btu per hr sq ft per degree F per ft length

For copper, h = 222

A = area in sq ft

Δt = temperature drop

L = thickness (20 ft in this case)

I did the problem in two steps, using in both the assumption that a linear temperature gradient is encountered.

The first step involves finding the time required for heat to just reach the cold end of the rod.

The mean specific heat of copper is

0.093 Btu per lb. The heat added up to the length L (see Fig. 2) is the

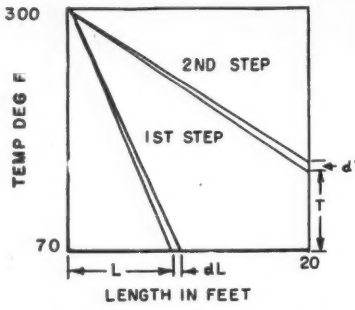


Fig. 2. Diagram by Lepley showing how heating of Fig. 1 rod can be considered in 2 steps

product of the specific heat, the weight up to L and the average temperature rise, or

$$\text{Heat added} = H = (0.093)(A \times L \times 556)\left(\frac{300 - 70}{2}\right)$$

$$H = 5960\ AL$$

$$dH = 5960\ A\ dL$$

$$R = \text{Rate of Transfer} = \frac{(222)\ (A)\ (300—70)}{L}$$

$$R = \frac{51100A}{L}$$

$$dR = -\frac{51100\ A\ dL}{L^2}$$

Negative sign shows rate decreases as L increases.

$$\text{Time} = \int_{L=0}^{L=20} \frac{dH}{dR} = \frac{5960\ A\ dL\ L^2}{51{,}100\ A\ dL} = 46.6\ \text{hr}$$

In the second step I found the heat required to raise the cold end temperature from 70 F to 300 F.

$$dH = (0.093)\ (A \times L \times 556)\frac{dt}{2}$$

$$dH = 25.8\ AL\ dt$$

$$R = \text{Rate} = \frac{h\ A\ (300 - t)}{L} = \frac{300\ h\ A}{L} - \frac{h\ A\ t}{L}$$

$$dR = \frac{h\ A\ dt}{L} = -\frac{222\ A\ dt}{20}$$

$$dR = -\ 11.1\ A\ dt$$

The negative sign here shows that as t increases the rate decreases.

$$\text{Time} = \int_{t=70}^{t=300} \frac{dH}{dR} = \frac{25.8\ A\ L\ dt}{11.1\ A\ \ dt} = 46.6\ \text{hr}$$

Total time, therefore, is 46.6 + 46.6 hours or 93.2 hours.

Philadelphia, Pa. R. C. LIPLEY

Determine It by Experimental Means, Says Heidecker

THE PRACTICAL method of answering this question would be to apply heat to one end of a rod or wire and measure the heat it conducts in a given time. The drawing shows a copper bar 1 sq. cm in cross sectional area; the upper end heated with a steam coil, the lower end submerged in a tank containing 3.9 cu cm of water. From observation we would find that the temperature of the water increased 0.5 C in one second. The total amount of heat transferred to the water in one second would be 0.5 C × 3.9 = 1.95 calories.

By means of a thermal contact, we would find that the temperature of the copper bar at "A" is 54.17 C, and at "E" it is 52 C. It is logical to assume that the flow of heat from "A" to "B" is due to the temperature differential between "A" and "B."

We are of the opinion W. S. would not be able to attain a temperature of 300 F on the cold end of his 20 ft rod by applying heat 300 F on the hot end;

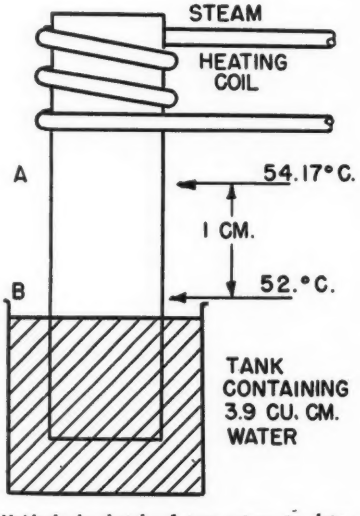
Table of Thermal Conductivity

Material	*Calories per cm per sec per °C per sq cm cross sectional area*	*Material*	*Calories per cm per sec per °C per sq cm cross sectional area*
Air	0.000054	Iron	0.15
Aluminum	0.49	Lead	0.08
Brass	0.26	Platinum	0.17
Cement	0.0007	Silk	0.0002
Copper	0.91	Silver	0.99
Cork	0.0001	Slate	0.005
Cotton	0.0005	Steel	0.11
Glass	0.002	Water	0.0015
Ice	0.005		

for the simple reason that, as the temperature of the cold end approached 300 F, he would lose his temperature differential.

The temperature differential between "A" and "B," Fig. 1, is sometimes called temperature gradient. The gradient for our copper bar is 5.17 C — 52 C = 2.17 C.

If we divide the amount of heat transferred, 1.95 cal, by the gradient, 2.17 C, we would get 0.9 calories, which is called the thermal conductivity of copper.



Heidecker's sketch of test set-up to determine thermal conductivity

The table shows a list of materials and their thermal conductivities. It is of interest to note that good conductors of heat are also good conductors of electricity. Since the conduction of electricity is explained by a drift of electrons, it is rational to ascribe heat conduction primarily to the mobility of free electrons.

Chicago, Ill. WALTER HEIDECKER

Another reader, Dott. Ing. Marcello Giomi, of Milan, Italy, has also worked out the problem, but because of the difficulty of presenting the higher mathematics he used, we will give here only his answers.

Mr. Giomi calculates that for a copper rod under the conditions given, it will take 248,750 hr for the cold end of the rod to reach a temperature of 297.4 F and 2490 hr for it to reach a temperature of 274.1 F. If the rod were of steel, he says, it would take 1,750,000 hr for the cold end to read 297.4 F and 17,600 for it to reach 274.1 F.

In a practical problem, you would not have perfect insulation, hence there would be temperature differentials and "steady state" flow. If actual insulation with low K value were assumed, it would be possible to calculate or assume a differential and determine how much heat would be required in a given time to raise the cold end to 300 F or how high above 300 the hot end would have to be raised.

Answer No. 343

HE WANTS DEFINITIONS OF UTILITY TERMS

WHAT IS the meaning of "firm capacity," "relay capacity," "reserved short-term capacity," "unreserved short time capacity" as used in modern utility practice? asked R.F.L. in the August 1946 issue.

It must be noted, says one of our electrical engineer readers, that definitions of terms of this type are based essentially on the application as agreed upon by qualified persons who have to use them; hence, in many cases, definitions based on "common sense" or on dictionary meanings may be misleading. They are definitely technical terms.

Furthermore, certain terms of this type may have additional agreed meanings related to the legal and accounting procedures of the utilities.

One engineer in a large utility system says that in his personal opinion, the above terms should be defined as follows:

Firm Capacity—Purchased power that is available as though owned in a generator of like capacity.

Relay Capacity—This probably refers to what is sometimes spoken of as "Relayed Capacity" or where an adjoining company has no spare capacity but can obtain capacity from a company beyond its system.

Reserved Short-Term Capacity—Capacity that is normally expected to be available in emergency for a short time, cannot be claimed as firm capacity.

Unreserved Short-Term Capacity—

Capacity that might be available but cannot be depended upon.

Another engineer says that firm capacity is the capacity definitely available whenever called for—the dependable capacity of any station, group of stations, system or combination of systems.

Other utility and power system terms are defined in American Standard Definitions of Electrical Terms, published by AIEE. Roget's Dictionary of Electrical Terms. Glossary of Important Power & Rate Terms, Abbreviations and Units of Measurement, published by Federal Power Commission (5c each from Superintendent of Documents, Washington, D. C. Supply not available now, but will be later).

Finally, we are informed that there has been some discussion of the above terms by an Edison Electric Institute Committee, but, as yet, not enough agreement on definitions has been reached to warrant publishing them.

Answer No. 345

WHERE SHOULD RELIEF VALVES BE INSTALLED ON ECONOMIZERS?

Comments by Slavinsky

IN THE DESIGN of his economizer, J.W.W. should give some thought to its accessibility for cleaning out tubes and soot, because this is one unit of any boiler that needs plenty of attention.

Soot blowers alone will not do the job. If this economizer will be installed away from the boiler, so as to pick up by-passed flue gases, he should give consideration to and make provision for washing the outside of the tubes, for they have a tendency to accumulate a hard, black scale, which the soot blowers do not knock off. It has been cleaned successfully by a stream of water. Another important thing to remember about economizers: use deaerated water. If feedwater has any oxygen in it, you can expect plenty of trouble from corrosion. I know, because I went through all of this.

In all my economizer observations, I have found that the relief valve was on the discharge or water outlet of the economizer. The stop valve and check valve must be placed between the economizer and the boiler. In every installation I have operated, the check valve was between the economizer and the boiler, in most cases near the boiler drum. Also, as an added protection, on our units we use a check valve on discharge side of boiler feed pump.

Another thing must be considered above everything else; that is to install a by-pass line and valves to by-pass the economizer in case of tube failure or to make other repairs.

The state I operate in is a code state and most of our safety rules regarding operation of pressure vessels are based on the ASME Codes.

Regarding the by-passing of the economizer, the ASME Code, paragraph C-322, reads "Where other than independently fired economizers are used, there shall be a water by-pass around the economizer."

Another important item I would like to pass on: install a vent valve and a blowdown valve.

The vent valve should be placed at the top manifold of the economizer and should be no smaller than a ¾-in. nipple and valve. The drain or blowdown valve can be a 1¼-in. valve and drain—or bigger if the economizer is a large one.

If J.W.W. desires any further practical information regarding his economizer, I will only be too glad to pass on what information I have on this subject.

Ridgefield, N.J. JOHN F. SLAVINSKY

Comments on Valving and Operation by Corder

IN THE ABSENCE of any particulars of J.W.W.'s installation, other than that the water inlet is at the gas outlet of the economizer and the water outlet is at the gas inlet of the economizer, the writer will assume that this is a water-tube boiler, connected in a battery with other boilers. If this is not the case, the solution or answer can be cut down to fit a single boiler installation.

Main feed valves are as required by the Boiler Code for boilers in a battery, with an excess pressure valve depicted, which will be necessary if this is a battery of boilers.

The boiler feed pump should have a check and a stop valve on the discharge for either single or multiple boiler installation, as a matter of course.

The economizer should have its own relief valve or valves, placed at the water outlet as in the sketch. A study of the sketch will make obvious the functions of the various valves. The drum stop and check serves to prohibit water leaving the drum in case the economizer check failed to work or if a feed line failure occurred. The economizer check serves the economizer alone in case of a bad leak or blown tube in the economizer; in which case it will be necessary to by-pass the economizer in order to keep the boiler from going dry. An economizer vent valve and blowdown valves are advisable to permit proper filling and draining. The installation can get along without an economizer outlet valve, provided the economizer check never sticks or leaks. The writer's experience with economizer check valves indicates that the installation of an economizer outlet valve may save a lot of headaches later on.

With the piping and valve arrangement shown, it is possible to cut out and make repairs to the economizer without shutting down the boiler. However if the boiler has a superheater, it will be necessary to reduce the boiler ratings in order to keep the steam temperature within allowable limits.

This brings to mind another point: that of cutting in the economizer with the boiler in service. This is a very tricky piece of business; in that the rate of water feed into the economizer (by means of economizer inlet valve), must be just right. Enough water must be fed so that it will not all flash into steam immediately upon entering the economizer, and yet reduced in flow enough that the boiler proper will not be robbed of water. Some experience will soon indicate how to handle the economizer inlet valve, and, of course, the economizer should be properly vented during this procedure.

J.W.W. does not say whether his boiler is now equipped with a superheater; in case it is, he had better consider what the installation of an economizer will do to his superheater temperature.

With the piping and valve arrangement shown, almost any eventuality can be taken care of, when combined with a little quick thinking. This may seem like a lot of expensive valves but, in case of trouble, it is not possible to cut the line and install a valve at a moment's notice. The writer believes that they are all well worth while, and may save several headaches and a lot of money later on.

This arrangement may not exactly depict J.W.W.'s installation, but he could probably arrange this piping to give the same results.

Baltimore, Md. T. E. CORDER

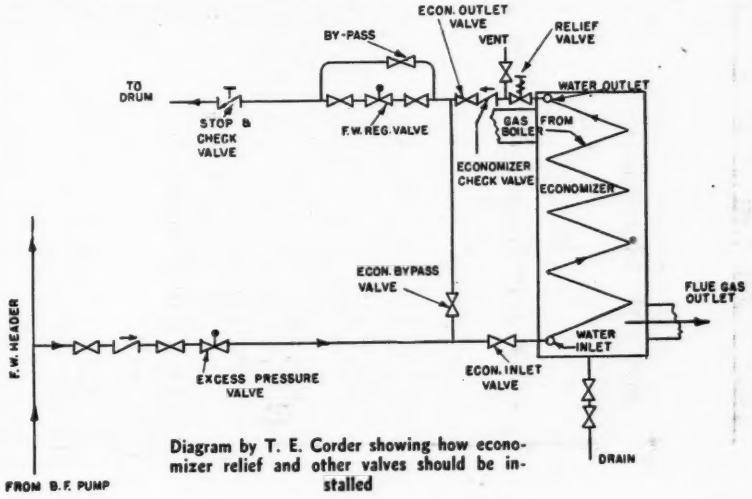
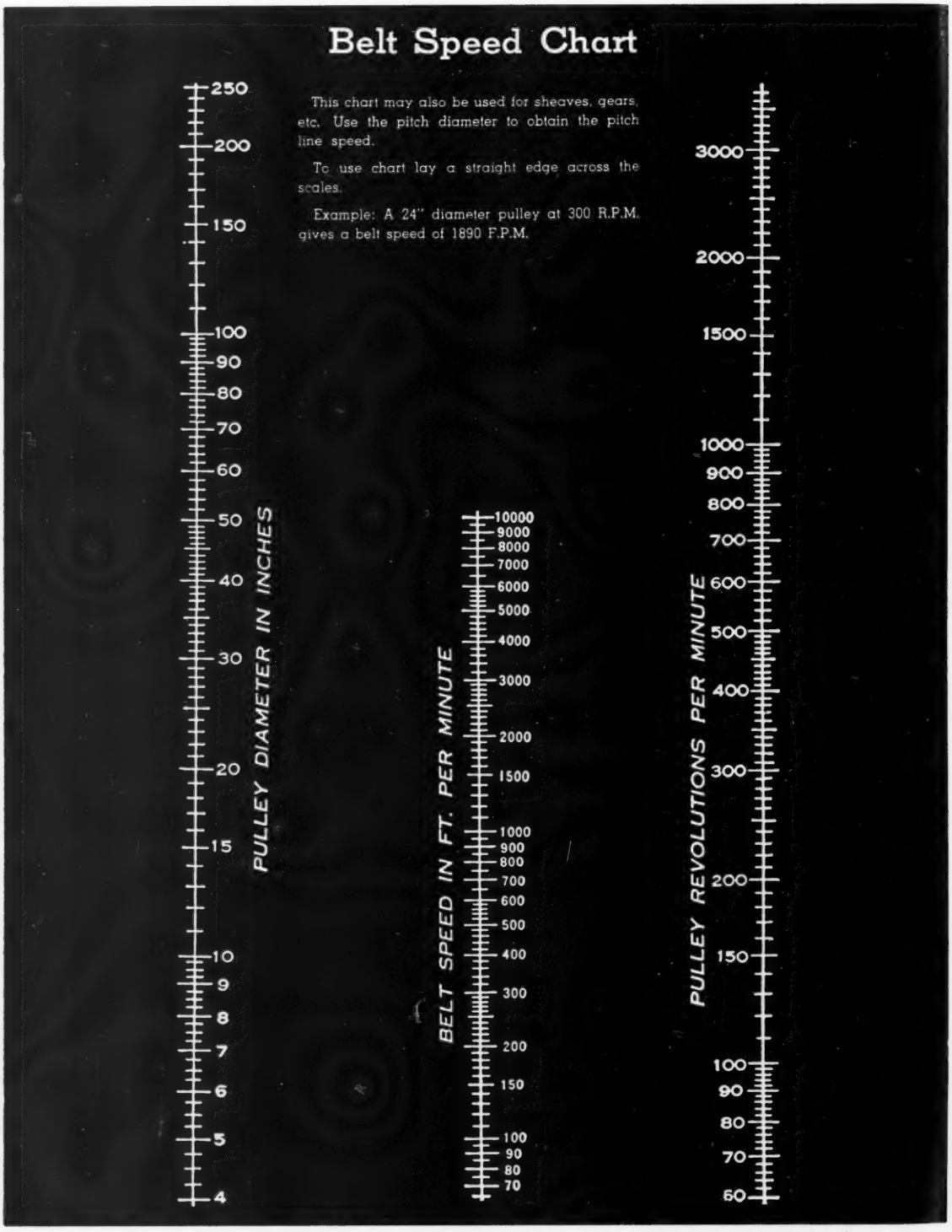


Diagram by T. E. Corder showing how economizer relief and other valves should be installed

Belt Speed Chart



Courtesy Dodge Manufacturing Corp.

How Compressed Air Systems Are Designed for TVA Hydroelectric Plants

By **H. J. PETERSEN**, Head Mechanical Engineer, Tennessee Valley Authority

COMPRESSED air is used in the hydro plants of the Authority for operating pneumatic tools, for generator brakes, for pneumatically operated regulating valves, for depressing tailwater below the runners for synchronous condenser-operation in those plants where tailwater level is normally above the runner, and in one plant (Kentucky) for preventing the formation of ice on the spillway gates.[1]

Pneumatic tools operate most efficiently using air at 80 to 100 psi, and since the other uses for compressed air require pressures of less than this, 100 psi has been adopted as a standard pressure for the compressors. One stationary 105-cfm compressor has been found to have sufficient capacity for all normal plant needs in all plants except Kentucky. This is supplemented by a portable machine of approximately 100-cfm capacity at each plant which is used when major repair work requires additional air capacity.

The Authority has standardized on a horizontal, crosshead type, double-acting, water-cooled, 325-rpm, V-belt-driven, single-stage compressor for the stationary machine. Its low rotative speed and low bearing loads, together with its all around rugged construction, make it a most dependable machine, capable of giving continuous service over a period of many years with very little maintenance. Dual control is used with these compressors. This control can be set to operate the compressor continuously when there is a steady demand for air, or it can be set to start and stop the compressor automatically when the demand for air is intermittent. The latter control is the one normally used, with the motor being operated by a pressure switch on the receiving tank. All compressors unload to atmosphere to prevent starting the motors under load.

The portable compressor is an air-cooled, single-acting, 2-stage, motor-driven machine complete with intercooler, air receiver, wheeled truck, and all standard accessories. The motor is controlled by a magneto starter and push-button station mounted on the machine. The compressor is motor-driven because electrical outlets are provided throughout each plant area which make it possible to use the compressor either in isolated locations, such as up on the roadway crossing the dam, or in the powerhouse to supplement the stationary machine.

A water-cooled aftercooler is always used after single-stage compression to remove the excess moisture in the air before it condenses in the distribution system. An "air through the tubes" type of aftercooler with moisture receiver at one end is installed in the discharge piping. The small amount of moisture and oil from the compressor cylinder carried over to the distribution line is removed by traps. These traps are placed at low points in the line for gravity drainage.

An air receiver is placed in the discharge line after the aftercooler to dampen the pulsations of the reciprocating compressor and to provide storage of compressed air when the peak demand is greater than the capacity of the compressor. Since the air cools in a receiver, its dew point is lowered and additional condensation takes place, which is removed by a blowoff or a trap. Because air is compressible, the damage resulting from a ruptured receiver is likely to be severe; consequently the Authority always specifies that the tank shall be fabricated in accordance with the A. S. M. E. Code for Unfired Pressure Vessels.

Certain features of design are observed in the layout of the compressed-air system; some of these are essential and others are desirable. The air intake is connected to outside air whenever possible and fitted with a filter. When this is not feasible, the compressor is located in the lower levels of the substructure where the air is relatively cool and clean. A valve is never placed in the discharge line between compressor and receiver without an intervening safety valve. All air-hose connections are made at the tops of headers to prevent picking up moisture. Cooling water is discharged through an open funnel so that it may be tested for temperature by feeling. The Authority uses black steel uninsulated pipe for air lines. Internal corrosions from condensate has not evidenced itself up to the present time.

The use of air for depressing tailwater below the runners[2] and for protection against ice at spillway gates[3] has been fully described in other articles and will be omitted from this paper.

Air Compressor, 105 cfm, 100 psi, and air receiver, 150 cu ft capacity, with connections, installed at Guntersville Dam Powerhouse

[1] From a paper entitled Design of Mechanical Auxiliaries for TVA Hydroelectric Plants, presented before Spring Meeting, ASME, Chattanooga, Tenn., April 1946. To be published in full in ASME Transactions.

[2] "Hydraulic Turbine Practice of the TVA," by H. J. Petersen and J. F. Roberts, Mechanical Engineering, vol 65, 1943, pp. 237-244.

[3] "Kentucky Dam Project of TVA, Part II," by C. L. Norris and R. M. Gardner, Power Plant Engineering, vol. 49, March, 1945, pp. 79-81.

Dissolved Oxygen in Feedwater Indicated by Electron Ray

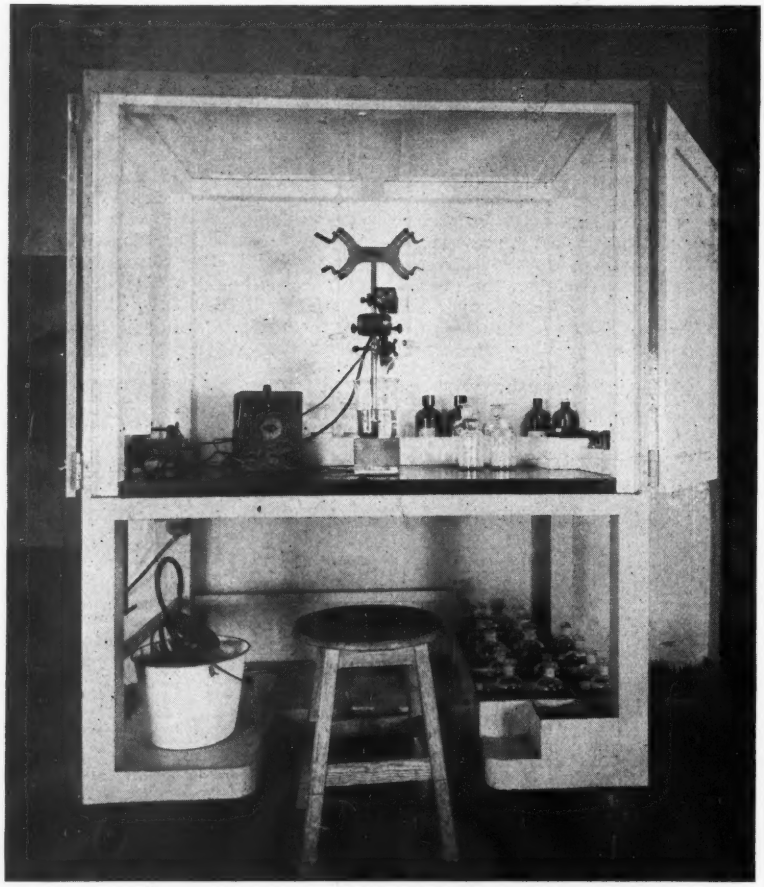
Precise method for indicating dissolved oxygen concentrations in boiler feedwater employs electron-ray end-point indicator developed by Research Department of the Detroit Edison Co. . . . Replaces Winkler method and color change visual observations . . . Portable cabinet houses equipment . . . Method helpful in locating air leaks

By J. M. DECKER Research Dept., The Detroit Edison Company

FOR MANY YEARS, the Winkler method for determining the dissolved oxygen concentration in boiler feedwater was used for control and investigative work in the plants of The Detroit Edison Co. Although that method left much to be desired in sensitivity and accuracy, use of it resulted in decreased corrosion and it was therefore considered to be satisfactory under existing conditions. However, when the Company installed new steam-generators that operated at higher pressures and temperatures than the old equipment, it became more important than before that very low concentrations of dissolved oxygen be maintained in the feedwater in order to protect the new equipment from damage by corrosion. As an aid in maintaining low dissolved-oxygen concentrations, a more precise method for the determination of such concentrations became highly desirable for the routine use in the plants.

Need for an improved method was recognized by Schwartz and Gurney [1] who proposed two modifications of the Winkler method. The more preferable of the two was further improved by Ulmer, Reynar, and Decker.[2] The novelty of the latter improvement consisted chiefly in the utilization of an electron-ray end-point indicator in place of the usual visual observation of color change produced by the starch-iodine reaction. This innovation greatly improved sensitivity and reproductibility. A second point of departure involved the expedient of collecting and treating samples under water. This latter innovation was suggested by Daugherty [3] and had been adopted by several chemists in the power station industry in order to insure the complete elimination of air from the samples.

Trials made in The Detroit Edison Co. indicated that the method, as improved by Ulmer, Reynar, and Decker, was suitable for use in the plants by personnel not trained as chemists and that it gave very precise values for dissolved oxygen in feedwater. Our experience showed, however, that it would be highly desirable to house the equipment used in the improved method in a portable cabinet to protect it from dirt and damage, and to facilitate use. A cabinet and the arrangement of equipment that have proved to be very satisfactory for use in power plants are described herein.



Oxygen testing equipment in portable cabinet

Equipment Housed in Cabinet

A front view of the cabinet with the doors open is shown in the accompanying illustration. Shown inside the cabinet are the end-point indicator, a motor-driven stirrer and control rheostat, burettes, electrodes, the beaker in which the titrations are carried out, and the reagents. In the lower part of the figure are shown a pail and manifold for collecting samples under water, a stool for the operator's use, and sample bottles. It will be noted that the cabinet is mounted on casters to facilitate moving it about in the plant. Fluorescent lights mounted behind the vertical reflectors, visible in the front corners of the cabinet, supply an abundance of soft

1 M. C. Schwartz and W. B. Gurney, "The Determination of Traces of Dissolved Oxygen by the Winkler Method," *Proceedings*, Am Soc Testing Mats., Vol 34, Part II, p 796 (1934).

2 R. C. Ulmer, J. M. Reynar, and J. M. Decker, "Applicability of the Schwartz-Gurney Method for Determining Dissolved Oxygen in Boiler Feedwater and Modification of the Method to Make It Especially Applicable in the Presence of Such Impurities as are Encountered in Power Plants," *Proceedings*, Am Soc Testing Mats., Vol 43, p 1258 (1943).

3 T. H. Daughterty, "Technique in the Determination of Dissolved Oxygen." *Proceedings*, Am Soc Testing Mats, Vol. 37, Part II, p. 615 (1937).

light. That part of the cabinet housing the titration equipment can be completely closed when not in use in order to protect the equipment from breakage and to keep it clean.

Four of these cabinets were built and equipped; one was placed in each of the company's plants, and operators were trained in the use of the equipment. These compact, portable assemblies made it practical to utilize in the plants the high sensitivity and reproducibility of the Ulmer, Reynar, and Decker method. These assemblies have been in use now for more than a year and have proved to be entirely satisfactory.

Since it has been possible, through the use of the equipment described in this paper, to use the more sensitive and more reproducible method in the plants, the values for dissolved oxygen obtained are accepted with more confidence than previously by the operating personnel. This is true for two reasons:

(1) The end point in the titration shown by the electron-ray endpoint indicator is definite, whereas that given by the fleeting color change of the usual titration is often indefinite.

(2) Consecutive samples from the same location give the same values unless conditions change.

Because of the increased confidence in the results on the part of the operators, sources of air in leakage are sought, found, and remedied immediately after high values of dissolved oxygen are reported. As a result, lower dissolved oxygen concentrations have been maintained in the feedwater and, consequently, it is reasonable to assume that a significant amount of corrosion has been prevented.

New All-Steel Motor

Size reduced, mechanical strength increased, electrical properties improved, prelubricated ball bearings reduce maintenance, windings simplified, many parts interchangeable among sizes and types

REPRESENTING a sudden advance above the normal rate of progress, a new alternating-current motor has been developed by Westinghouse Electric Corp. which, known as the Life-Line, is more than 35 per cent smaller in size than its predecessor. The reduced size, according to F. C. Rushing, Manager Motor Enginering, has been accomplished without sacrifice of electrical properties. Starting torques have been increased as much as 134 per cent per pound of motor and maximum torques increased as much 116 per cent per pound of motor. High efficiencies and power factors are maintained, and maintenance requirements are materially decreased. Shock resistance is increased many-fold. Vibration and noise have been reduced to new low limits. Fewer insulation burn-outs will be experienced because of new features in insulating materials and improved winding techniques.

New materials, new methods, new processes, and new tools went into the development of this motor. A large new factory in Buffalo, N.Y. has been purchased for its production.

Steel is used instead of cast iron to make this motor stronger, and the finish coating consisting of base coats of baked thermoset varnish with a final coat of lacquer makes it adequately corrosion resistant. Its use is not entirely new; however, in this motor the novelty is that the structural steel sections are as thick as they would be if made from cast iron. Normal inclinations are to use thinner sections of steel than cast iron, and frequently steel motors have been justly classed as sheet-steel motors.

Fig. 2. Partially wound stator has slots to be sealed with wooden wedges

Fig. 4. Locating crossover sleeve on continuous wound coil of Life-Line motor

Shock resistance of steel is much greater than cast iron as became evident during the War when use of cast iron on Naval vessels became taboo because of its low shock resistance. Steel motors had to be developed and much experience was obtained in their use. Thus the War experience is reflected in a peacetime motor of marked increase in shock resistance and ruggedness.

Fig. 1. Comparative size of 7½ hp motors—Life-Line motors shown by solid lines, last year's models dotted

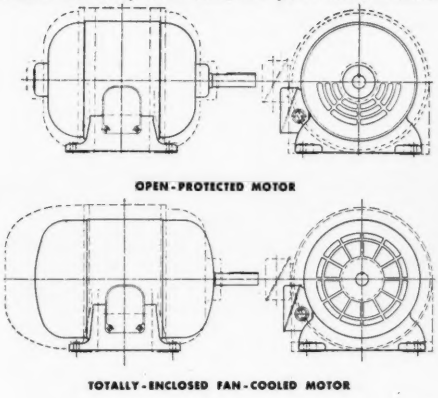
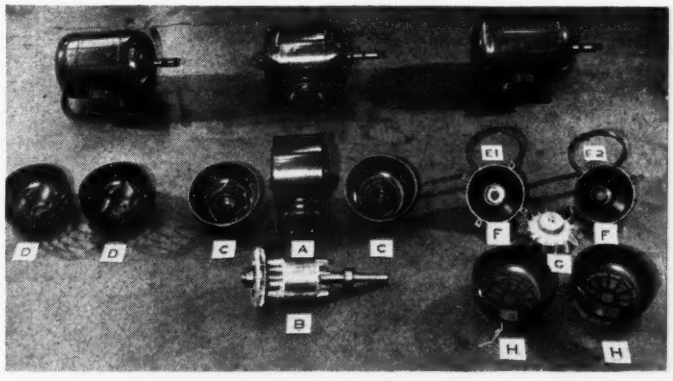


Fig. 3. Various elements of motors illustrate interchangeability among types



It is a fallacy that steel corrodes faster than cast iron. Research tests demonstrate the two materials to corrode at equal rates. The explanation for the common belief lies in the fact that when cast iron is replaced by steel, the steel is usually of thinner section and will rust through sooner. Where thick steel sections are used, excessively rapid corrosion is not experienced.

The use of steel has resulted in a smaller size. Size is also reduced by an improved engineered cooling system. Comparative motor sizes of 7½ hp ratings are shown in Fig. 1. The open-protected machine is 83 per cent as large in diameter and 94 per cent as long or a saving of 35 per cent of the volume of last year's machines. The new totally-enclosed motor is 83 per cent as large in diameter and 82 per cent as long, saving 44 per cent of the volume of its predecessor. Size reduction has resulted largely from elimination of superfluous cast iron. Sizes of electrical working parts have remained substantially the same. Losses in a motor are inherent and are dissipated in the form of heat. Temperature rise beyond a certain point is not allowable because of detrimental effects on electrical insulation and the heat must be carried away from the motor. Most of it is transferred to air blown over the hot surfaces. Much more air passes through this motor than through its predecessor, thus permitting the reduction in size of the cooling surfaces while adequately maintaining temperature limits.

Completely proven prelubricated ball bearings are used throughout the line. They require lubrication no sooner than five years after the motor is placed in operation.

To simplify and facilitate the winding process, slot shapes and sizes, coil shapes and sizes, and connections were all redesigned. The slot openings were enlarged. The result is that winding is much easier and there is less handling and bending of the coils with a consequent reduction of damage. Fig. 2 shows a partially wound stator.

Winding materials are of high quality, synthetic resin-covered wire. Multiple dips and bakes of thermoset varnish give a hard smooth, and well-protected winding. The shortened coil extensions are less vulnerable to damage.

Several types of motors are attained through extensive interchangeability of parts. Fig. 1 shows an open-protected motor which can be made wall mounted or ceiling mounted by orienting the brackets 90 or 180 deg respectively from the location shown without sacrifice of protection.

Figure 3 shows three popular types with their component parts. Left to right are splash proof, open-protected, and totally-enclosed fan-cooled. The open protected consists of stator, A, brackets, C, and rotor assembly, B. To make it splash proof the brackets, C, are oriented with their openings facing upward and the hoods, D, placed over the ends. Space between the hoods and the brackets allows air to enter and leave.

To make a totally-enclosed fan-cooled motor the frame, A, and the rotor, B, without fan are used with brackets, F, spacers, E-1 and E-2, blower G, and hoods H. The brackets seal the inside and support the bearings. Air, pulled in through a hood, is directed between the frame ring and the stator iron, and exhausted out of the other hood. Conduit box may be reversed by reversal of the frames on each of these three types.

Tests of 1000-kw Packaged Steam Power Plant

Typical plant designed for war-time foreign service with low-grade fuel and water . . . Delivered in 18 packages of pre-assembled units . . . Set up in New Jersey to demonstrate ease of erection . . . Estimate of 1967 man hours, 36 working hours for erection . . . Burning Texas lignite, plant showed heat rate of 20,317 Btu per kwhr on test as compared to prediction of 20,410 Btu

THE FUNDAMENTAL principles of design of many of these plants, as carried out by Peter F. Loftus Corp., was discussed in detail in the August 1944 issue.*

While that article referred to design. of a 500 kw plant, the same principles were applied to design of plants of other capacities. These principles include design of the equipment in functional assemblies so that they can be shipped in packages of suitable size to meet domestic and foreign railway clearances of weights adapted to handling facilities. Shape of the various packages was also a factor. Speed and ease of field erection influenced the design, also simplicity of operation by inexperienced crews. The plants had to be capable of burning low grade fuels available in Russia, China, Manchuria, and of operating with available water supplies.

To hold equipment sizes down, steam conditions were usually taken at 300 or 400 psi, 700 F. Condensing type plants were used for the same reason, even though more complicated than non-condensing, thus reducing steam demand even at the expense of an increase in the total number of packages required. Standardized equipment units were used as widely as possible.

Recently, to demonstrate the ease with which a packaged power plant of this type can be erected and to test the performance of the assembled plant, a 1000-kw packaged plant was erected at the shops of Foster Wheeler Corp. at Carteret, N.J. In the 1000-kw size, the entire plant is delivered in eighteen crates or packages, many of which contain large pre-assembled sections of the plant. On the basis of records kept of the erection job, it is estimated that a skilled crew can complete erection of this 1000-kw plant with 1967 man hours of labor and in an elapsed time of 36 working hours.

The steam generating section of the plant consists of a complete shop assembly of a two-drum boiler with water-cooled furnace, drainable superheater and extended surface economizer, designed to deliver steam at 400 psi, 750 F. It is designed for normal operation with coal fired by a spreader stoker, but wood-burning grates are provided below the stoker for use when neither coal nor lignite is available. To burn wood, the stoker grates are removed and the coal delivery openings sealed; however, the wood grates remain in place when the stoker is operating.

Combustion air is supplied by a motor-driven forced-draft fan consisting of two single-stage blowers in series. A motor-driven induced-draft fan removes combustion gases from a plenum chamber below the economizer and discharges them through a 30-ft venturi-type steel stack. A steam jet in the bottom of the stack provides sufficient draft to bring the unit up to operating pressure before power is available to the motor of the induced draft fan.

The steam generator is controlled by an all electric combustion control system, with provision for instant transfer to semi-automatic or manual operation. Suitable fly-ash hoppers are provided

* Package Type Power Plants, by H. H. Van Kennen and Lester E. F. Wahrenburg; *Power Plant Engineering*, August 1944, page 68.

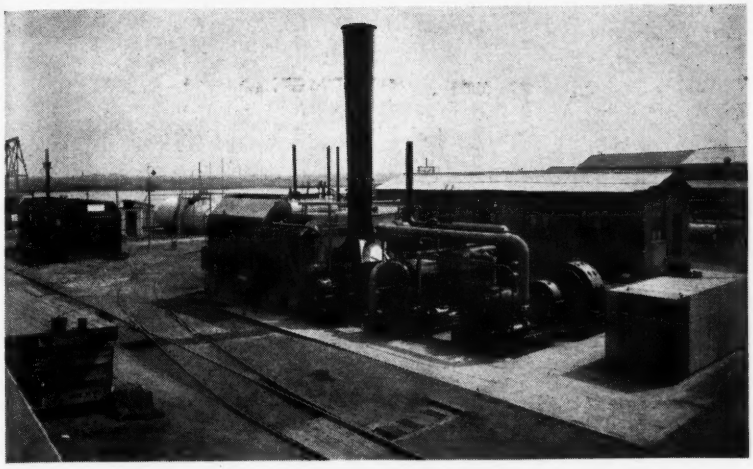


Fig. 1. Completely assembled 1000-kw packaged steam plant ready for test

and a single valve-in-head soot blower runs horizontally through boiler, superheater and economizer, so that all tubes can be cleaned in one operation.

The turbine generator assembly consists of a 4500-rpm steam turbine driving a 1000-rpm generator through a helical reduction gear, with the exciter mounted directly on the generator shaft. The entire generating unit, including governor and oil pump and other accessories, is mounted on a structural steel frame that serves as both a skid and a foundation.

The turbine receives steam at 400 psi, 750 F, exhausts to the condenser at 3 in. Hg absolute and is provided with an extraction point for supplying steam at 47 psi absolute for feedwater heating.

The generator is rated at 1250 kva, 0.80 pf, 3 phase, 6300 v. For many foreign applications, the unit will operate at 1000 rpm to produce 50 cycles, but is capable of 1200 rpm to produce 60 cycles.

The condenser assembly consists of a two-pass, 1060-sq ft surface condenser, a motor-driven condenser circulating pump of 1765 gpm capacity against 40.9 ft head; a 38-gpm 85-ft head motor-driven condensate pump; a twin two-stage steam-jet air ejector. A two-cell, induced-draft redwood cooling tower, designed to be shipped completely erected on a single flat-car, is also provided.

The feedwater system, arranged in a single assembly, includes water clarification, softening, treating, heating and pumping equipment. Treating equipment consists of a pressure filter, two Zeolite softeners, a transfer pump and a backwash pump.

Feedwater is heated by a jet type deaerating heater designed to meet oxygen guaranties of 0.03 cc per liter delivering 16,000 lb per hr; or to deliver 20,000 lb per hr at higher oxygen content. It is mounted on a 2700-lb capacity storage tank. Feedwater heating steam is obtained from boiler feed pump exhaust, supplemented by main turbine extraction steam. Feedwater is pumped by two vertical 48-gpm, 1070-ft head simplex pumps.

Other auxiliaries include: a complete switch-gear in a single unit; coal and ash handling units; power transformer; piping and electrical wiring; a 5-ton, 23 ft traveling crane.

After erection of the above plant, complete tests were run using Texas lignite as fuel, equivalent to many fuels available abroad. Guaranties were based on a fuel of 7435 Btu per lb, 19 per cent moisture. The Texas lignite had 6552 Btu per lb, moisture 36.3 per cent. With this fuel, the tests showed a gross heat rate of 20,317 Btu per kwhr as compared to the guarantee of 20,410 Btu per kwhr. Steam generator efficiency was 77.7 per cent compared to a predicted value of 75.9.

In a 4-hr capacity test, the boiler produced 16,689 lb steam per hr, 5.1 per cent above guarantee. The turbine generator maintained an average output of 1189 kw. Difficulties with the control of the water rheostat prevented continuous maintenance of the 1250 kw output, but the latter value was attained over several short periods.

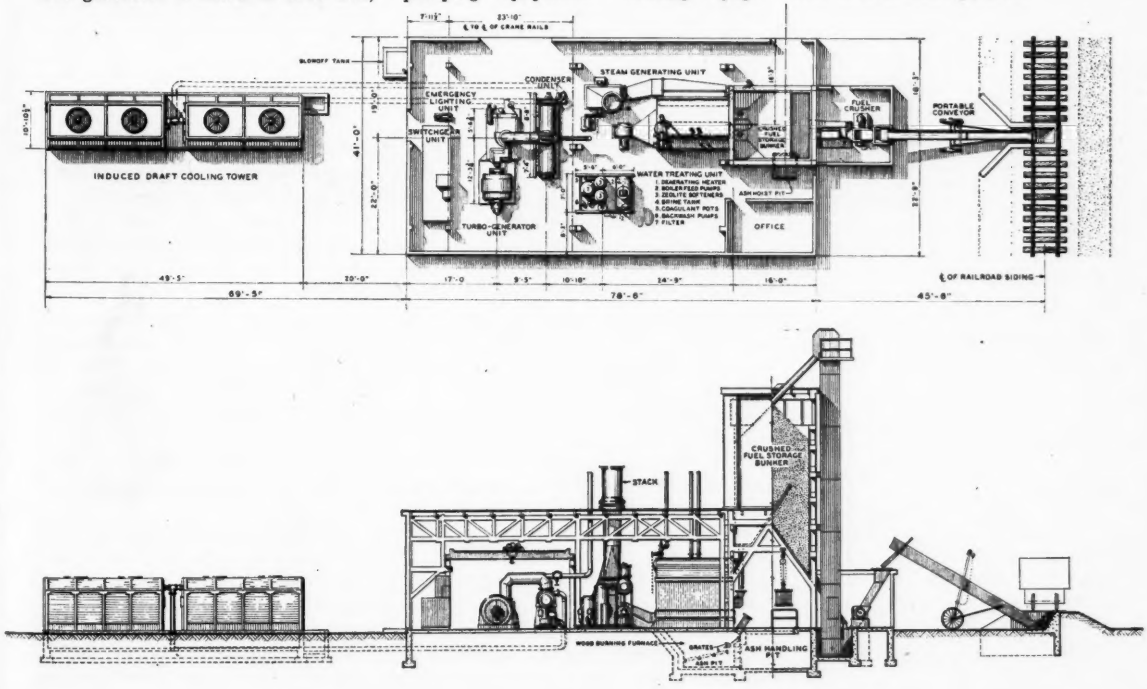


Fig. 2. Plan and elevation showing typical general arrangement of 1000-kw packaged steam power plant

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Use of Radioactive Tracer in Measuring Condenser Water Flow

By S. KARRER,[1] D. B. COWIE,[2] and P. L. BETZ [3]

IN INVESTIGATIONS of the performance of steam power plants, a knowledge of the rate of flow of cooling water through the steam condenser is often desirable. A volumetric measurement of the flow is usually impossible because of inadequate facilities. Flow meters could be used, but it has not been customary to provide for such installations. A close approximation of the flow may be made if the characteristics of the pump are known, but these may change with time, and independent means for detecting such change would be useful. Generally the heat balance method is the only one available. However, in this case the flow rate comes out as a derived datum, whereas it is desired as a primary datum if the operations of the plant are to be checked by it. Sometimes the velocity of a slug of salt solution through a known volume can be measured by noting the time interval between its injection and its appearance at some definite point downstream. If the turbulence is such as to diffuse the slug, the method can give only approximate results. Still another possibility is the salt titration method. In this a salt solution of known strength is added to the inlet water at definite and known rate, and, if thorough mixing takes place, the concentration of salt in the effluent water will be determined by the rate of flow of the water. A relatively large quantity of salt must be used to give reasonable accuracy because of limitations in measuring salt concentrations. Further, the method reduces to one of measuring a difference between two values when the cooling water already contains some salt, as is the case with tide water plants. Of course, whenever a choice is possible, such metal salts would be used whose measurement is possible in the highest dilution. An appropriate dye could be used if it can be shown that it is not lost by some process, such as adsorption. However, the mineral content and the presence of disturbing organic and colloidal matter must always be taken into account.

The present paper reports the use of an adaptation of the salt method in which a radioactive tracer element is used in the injected solution. There are some advantages in this which seem worth while. For example, an element can be selected which would not be lost by precipitation or chemical combinations, and yet be distinguishable by its radioactivity from similar atoms already present. The nature of the chemical combinations into which the element may enter, or its adsorption on suspended matter should not influence the results.

The various naturally occurring chemical elements can now be transmuted to other atoms endowed with a type of nuclear instability which leads to the emission of energy in some form; that is, they become radioactive. The natural and the artificially-produced isotopes of an element cannot be distinguished by

The use of radioactive tracer isotopes was one of the most widespread applications of nuclear physics before the development of the atomic bomb. The method of radioactive indicators was a natural development from Madame Curie's initial radiochemical work during the experiments on the discovery and separation of polonium and radium. As early as 1913 Paneth and Hevesy made the first application of this method to chemical problems. The groundwork and the fundamental method of tracer isotopes all were well worked out before 1930. There were severe limitations on the early work however because only the naturally radioactive isotopes were available. With the discovery of artificial radioactivity in 1934 by the Curie-Joliots and the perfection by Lawrence of the Cyclotron the whole art gained new impetus, and the use of isotopes as tracers became a major field of applied nuclear physics during the middle and late 1930's. Only then were tracer isotopes of all the chemical elements discovered and made available in quantities, together with the means for detecting them.

Until the present time radioactive tracers have been used largely in the field of medical diagnosis. Now, however, in this article by Messrs. Karrer, Cowie and Betz, is described an application of the tracer method in power plant engineering, specifically, in the measurement of cooling water flow through condensers. The fact that this method has been successfully applied is of great importance because it paves the way for other developments in this field. We feel privileged to present this first account of this method to the readers of POWER PLANT ENGINEERING.

1 Formerly Director of Research, Consol. Gas, Electric Light and Power Co. of Baltimore, Md. Now of Research & Development Division, New Mexico School of Mines, Albuquerque, N.M.
2 Carnegie Institution, Washington, D.C.
3 Research Engineer, Consol. Gas, Electric Light and Power Co. of Baltimore, Md.

chemical means, as both possess the same outer electron structure on which chemical behavior depends. However, these isotopes can be distinguished by observing effects of the specific radiation emitted from the unstable atoms during the disintegration process.

As is now generally known, radioactivity may be produced by subjecting an element to bombardment by high velocity particles as, for example, is done in a cyclotron, or this activity may be produced by exposure to neutrons from some appropriate source such as the uranium pile. Starting with a sample of a stable chemical element, a certain fraction of the atoms may be altered. In favorable cases, this fraction may be one in a million, or even as much as one in 100,000.

All that is necessary, then, for the flow measurements here considered is a scheme for measuring the number of unstable atoms present in a sample under any circumstances. There are several methods for doing this which depend on determinations of the number of atoms transmuting per unit of time. The rate of transmutation per unit mass is constant for any given isotopic change. In the present investigation the strength of a radioactive sample was measured by counting and recording the number of radiation quanta from the disintegrating atoms which passed through a given space, namely the volume enclosed by a Geiger-counter immersed in a definite volume of the radioactive solution. The estimation of the number of radioactive atoms by this means can be made both sensitive and reliable, but the total radiation recorded will depend, of course, on the disposition of the Geiger-counter tube with respect to the radioactive sample and this in turn will be dictated by the nature and energy of the radiation to be measured.

More specifically, the determination of the rate of water flow through a condenser cooling system, for example, involves the injection of a solution containing radioactive atoms into the cooling water at a known and constant rate. During its passage through the circulating pump and the condenser, the solution will be thoroughly mixed with the cooling water. Samples collected at the exit side of the condenser will, after a certain time, following the start of injection, show a constant concentration of the radioactive atoms. If the radioactivities of the original solution and of the exit water samples are determined, the rate of flow of cooling water can be calculated from the obvious relation

$$Q = R \times \frac{C_1}{C_2} \qquad (1)$$

where

Q = rate of flow of cooling water
R = rate of injection of radioactive solution
C_1 = concentration of radioactive solution injected
C_2 = concentration of radioactivity in the effluent water

Q will be expressed in the same units as R.

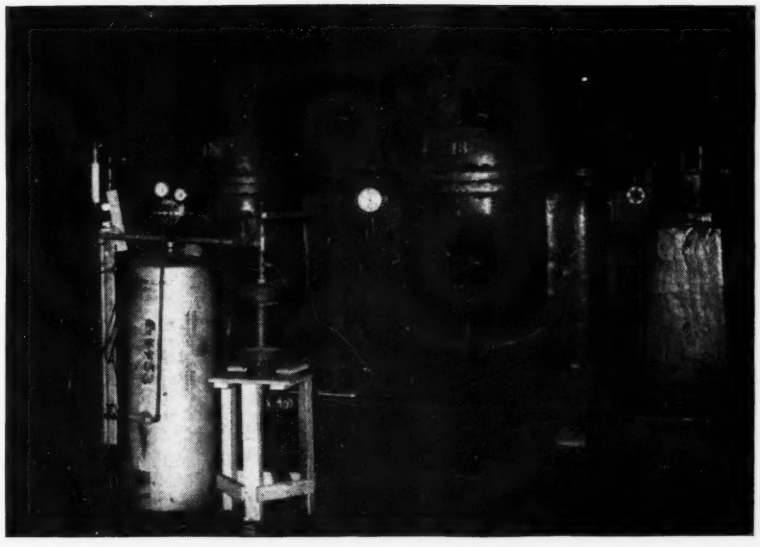


Fig. 2. Photograph of the radioactive tracer equipment

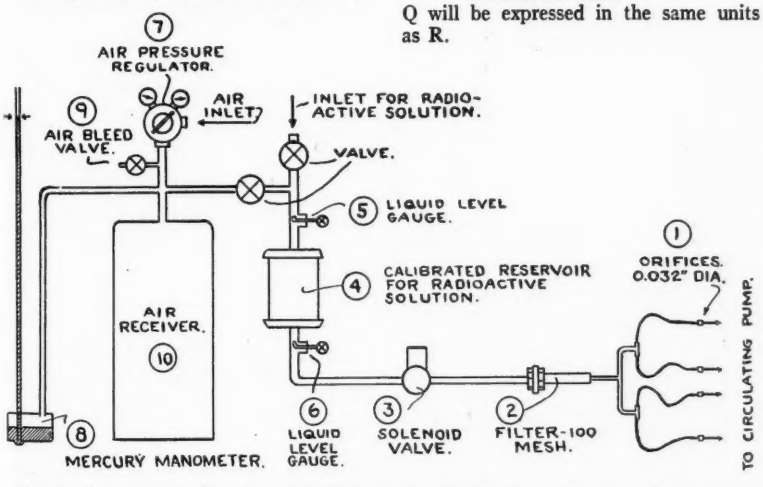


Fig. 1. Arrangement of equipment in the use of radioactive tracers in measuring condenser water flow

This method as outlined was used in determining the rate of flow of cooling water in one of the condensers at the Westport station of the Consolidated Gas Electric Light and Power Co. of Baltimore.

The circulating pump associated with the condenser under test had two impellers with water entering from both sides of each impeller. The radioactive solution was introduced into each of these water paths (4 in all) through calibrated orifices.

Figure 1 is a schematic diagram of the injection apparatus. The calibrated orifices, 1, are connected to the circulating pump at the chosen points. Tracing backward from this point, the path of the radioactive solution includes a fine mesh filter 2, a solenoid valve 3, for controlling the injection period, and a calibrated liquid reservoir, 4. Reservoir 4 is provided with two liquid leveling gages 5 and 6. The upper gage, 5, permits the accurate leveling of the radioactive solution prior to the start of injection, when the system up to this point is completely filled with radioactive solution. During injection air pressure is applied to the solution in the reservoir, thereby forcing the solution through orifices 1 and into the circulating pump. During injection the liquid level falls in reservoir 4, but the experiment is so arranged that, at the end of the injection period, the lower liquid level gage 6 is not uncovered by the liquid. The volume of reservoir 4 between gages 5 and 6 is known from previous calibration so that the amount of solution injected is readily determinable at the end of the experiment by drawing off the solution remaining in reservoir 4 by means of liquid level gage 6. The volume of the unused solution is determined and the quantity injected during the test is thus determined.

The pressure of the air admitted to the system is controlled roughly by

regulator 7. A mercury manometer 8 permits the accurate determination of air pressure during the injection period. Manometer 8 is terminated with a glass tube so that the mercury level can be observed and can be maintained at the desired point by the manual operation of air bleed valve 9. Air receiver 10 provides a relatively large volume and serves to minimize the variations in pressure applied to the radioactive solution. Figure 2 is a photograph of the injection apparatus as connected to the circulating pump.

The time of injection was determined with a photographic timing device that gave the injection time in terms of the number of half cycles of a 60-cycle wave.

A sequential timing device controlled the various steps during the progress of the test. This device provided signals when samples of the water were to be taken at the exit end of the condenser after a predetermined time period following the start of injection of radioactive solution.

After a definite time interval following the start of injection of the radioactive solution, the radioactivity made its appearance at the exit end of the condenser. In many applications of this method this interval can be calculated closely enough so that the samples can be taken with assurance that the active solution is included. There was some uncertainty about the time required in the test because of the manifold into which the pumps discharged. At any rate, it was desired that the collection of water samples be begun prior to the arrival of the active material at the sampling device, for the manner in which equilibrium of radioactivity was attained was of interest to us as well as the final equilibrium value from which the flow was to be determined.

The sequential timing device referred to above gave signals at subsequent time intervals when samples were to be taken. These samples were then tested for their concentration of radioactivity, and similar tests were also made on a definite amount of the radioactive solution originally injected into the cooling water. If these two measurements are made simultaneously, the noted decay constant of the radioactive material is of no concern and actually need not be known, thus obviating the need for high purity of the active substance. From these data the rate of flow was determined in accordance with equation (1).

Test Results

Because the manifold mentioned above to which the pumps were connected contained a dead end of considerable volume, within which there was some mixing of active material, the estimate of the time required to attain equilibrium in the exit water was unreliable, so several tests were made to determine the time interval between the start of injection of the radioactive solution and evidence of its presence at the exit end of the condenser, and also the length of time during which the radioactive solution would have to be injected to attain a constant concentration in the exit water. With the completion of these preliminary tests, the final one was undertaken with confidence and yielded data as follows:

Quantity of radioactive solution injected	4546.0 cc(1.2 gal.)
Injection time	125.35 seconds
Injection rate (R)	36.185 cc/second (.00957 gals./sec.)
$\frac{C_1}{C_2}$ — Corrected for time of measurement	57446

$$Q = R \frac{C_1}{C_2} = 36.185 \times 57{,}446 = 2{,}078{,}683 \text{ cc/sec.} = 549 \text{ gals./sec.}$$

The concentration measurements on the various water samples show at first rising values extending over about a minute and then constant or equilibrium ones. Any value in this constant plateau period could be used to calculate the flow. However, the final figure of 549 gallons per second given above is based on a total of 11 samples taken over a 33-second period and is probably correct to within one per cent. The injection rate (R) given above includes a correction for the fall in liquid level in the calibrated reservoir (4 in Fig. 1) during this 33-second period.

This accuracy was attained so far as the radiation measurement was concerned because the total radiation quanta recorded from the solutions amounted to over 40,000. It is apparent that the accuracy with which electrical quantities are usually measured in a power plant can be attained in the measurement of flow of the cooling water. The results reported here were obtained with a relatively small amount of radioactive material and the method of measurement was not especially efficient because it depended upon the detection of gamma rays in an inefficient gamma-ray counter. The short life isotope of sodium was chosen for use because considerable sodium was already present in the cooling water and there was thus no question of loss of active material. Moreover, this isotope was available in the quantity required for this preliminary investigation. It was introduced as the chloride.

In general the results can be obtained from fewer samples and the sampling apparatus can be very simple. Moreover, if strong radioactive materials are available, which was not so when these tests were made, a relatively long time of injection can be used and therefore the time of the equilibrium or plateau values in the effluent water need not be known very closely. The time for a complete test in favorable cases need be no more than a few hours.

It is believed that the method used here will prove to be of value in certain plant investigations.

We are indebted to Mr. A. L. Penniman, Jr. General Superintendent, Electric Division, for making these tests at the plant possible.

U. S. PUBLIC HEALTH ENGAGES IN NUCLEAR RESEARCH

THE ENTRANCE of the U. S. Public Health Service into the nuclear research program at the Clinton Laboratories, operated for the government by the Monsanto Chemical Company, and the organization of a new biological research division as a cooperative undertaking with the National Institute of Health was announced recently, at Oak Ridge, Tenn.

The announcement, made jointly by the National Institute of Health, which is the research branch of the U. S. Public Health Service, and Monsanto Chemical Co., was approved by the Manhattan District. The program will includes extensive research into the effect of nuclear radiation upon living cells. Considerable study must be done to determine the maximum safe exposure to nuclear radiation for workers in this field before atomic energy can have a practical use in industry.

Dr. Alexander Hollaender, principal biophysicist of the National Institute of Health, will direct the program as head biophysicist assigned to the Clinton Laboratories. He will be associated with Dr. Eugene P. Wigner, research director of the Laboratories.

Hollaender, who twelve years ago made a survey for the Rockefeller Foundation on the biological effects of electromagnetic radiation, will use the radiations available at Clinton as a result of nuclear disintegrations within the pile. These include radiations emitted by substances irradiated in the pile and radiations emitted by the new sources of penetrating irradiations, such as from the betatron.

Most of the biological work done in connection with the Manhattan Project during the war of necessity concerned itself with practical problems of a biological nature. Animals were used to determine the limits of tolerance for men working with nuclear energy. This practical approach to tolerance was necessary during the time of emergency because of the limited time available for preparing the raw materials for the atomic bomb. While the work on tolerance will be continued in a limited way in the biological division, the main effort will be shifted to the more basic aspects of radiation work, such as:

1. What is the lowest dosage of radiation which will interfere with the normal function of a cell?
2. Will this effect be the same if the minimum energy is given in a fraction of a second or spread over many hours?
3. Will this effect be the same if radiation originates outside the cell or if the radiation is emitted within the cell?

The need for answers to these questions is urgent. Before there is a rapid development of nuclear energy by industry, it will be necessary to solve problems of maximum safe exposure. At present this is the major public health problem in connection with the practical use of atomic energy.

Electrical Features of Springdale's New 80,000-kw Unit

By **H. A. P. LANGSTAFF** Electrical Engineer, West Penn Power Co.

WEST PENN Power Co.'s 1945 generating capacity addition was made at the Springdale Station by the installation of a 65,000 kw turbo-generator, an extension to the south end of the plant as described in the July, 1941 issue of POWER PLANT ENGINEERING. The station already included 240 mw in five 1800 rpm turbo-generators and one 50 mw 3600 rpm superimposed high pressure unit.

The new No. 7 Unit is an 81,250-kva 80-per cent pf, 60 cycle, 3600 rpm, 11,-500-v hydrogen-cooled, condensing turbo-generator complete with step-up transformers and all necessary auxiliaries connected to one 800,000 lb per hour boiler at 1325 psi. This is almost an isolated unit electrically, with no paralleling of circuits under normal operation other than at 132-kv. A few of the auxiliaries are supplied from the existing station.

If future operation requires the new and old auxiliary buses to be normally tied together, space is provided for the installation of reactors to limit the current flow between the new and the old switchgear.

Generator and Connection

The generator is capable of delivering 115 per cent of rated kva at 0.8 pf when operating in hydrogen at 15 psig. p. In the neutral of the generator are installed current transformers for metering, relaying and voltage regulator with space provided for compensators for use with an electronic exciter. A complete description of this exciter appeared in POWER PLANT ENGINEERING, April, 1946. The neutral is connected through disconnects to a 150-kva, 12,000-480 v grounding transformer across the secondary of which is a resistor and indicating instruments.

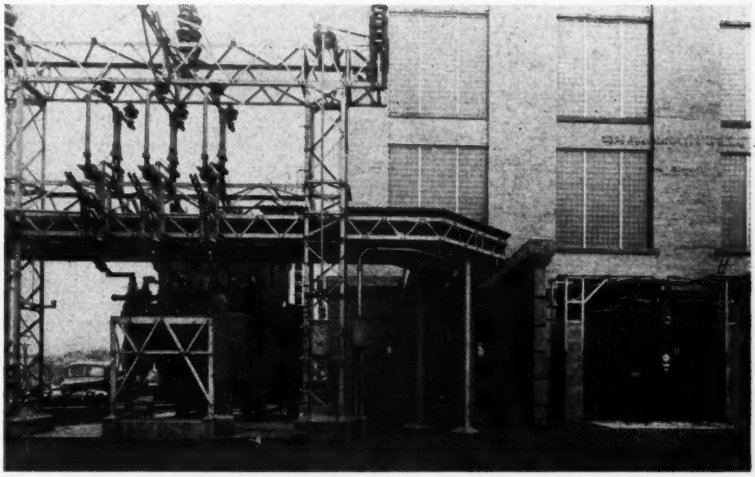


Fig. 2. Overhead support for generator cables to 15-kv breaker, 45,000-kva transformer, 161-kv motor-operated air-break switch and 7500-kva station auxiliary transformer

Twelve 2-million cm Anaconda section, 12-kv Kerite cables were used in stead of bus work, to provide a continuous copper connection from the generator terminals to the oil circuit breakers and transformers. These cables, supported in ebonywood cleats on a fabricated steel structure, extend up the inside face of the turbine room wall to an outdoor overhead structure, which allows for ample radiation and protection from possible flood waters.

The two 45,000 kva 3-phase General Electric transformers are located within 240 ft of the generator and approximately 100 ft apart, providing good segregation, eliminating the use of fire barriers and permitting direct connection of the high-tension sides to their respective sections of the 132-kv bus.

It was specified that the transformers should be as clear of external attachments as possible. This has resulted in the best appearing units of any yet produced. One large cabinet houses the thermometers, main 220-v control switches, thermal relays, the gas control unit, bottle, numerous secondary cable terminals and the nameplate. The side of the cabinet through which the conduits from the concrete foundation extend, is arranged as a disconnecting device such that it can be unbolted and freed to permit removal of the transformer whenever necessary. Terminal blocks and copper strap jumpers permit disconnecting of the wiring within the housing.

Each transformer is equipped with three standard heat exchangers, each consisting of one oil circulating pump with three fans operating as a unit. They are located on the side of the transformer adjacent to the switchgear. The top of the power transformer was kept as clear of conduits and accessories as possible. All current transformer secondaries are encased in fibre tubing supported under the cover and extended into one large secondary wall. From there to the large control cabinet are run only those wires which are actually in use.

Rather than have two large manholes and one pressure relief valve, the speci-

Fig. 1. Generator field circuit breaker cubicles and hydrogen storage and control units

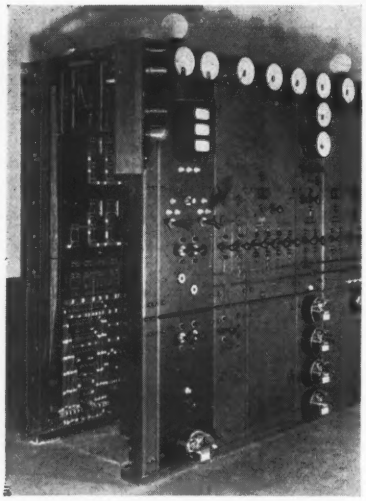


Fig. 3. Extension to 2300-v station auxiliary panels for control of auxiliary bank, section and auxiliary bus tie breakers

fications called for one large manhole and two relief valves. The tap changing control handle was not extended down the outside of the transformer. The transformer cover was welded in place. A 2-in. combination drain and sampling globe valve is used rather than the usual large drain and small sampling units. The oil level gage is the only visible instrument. Cable connections extending from the top of the transformer into the large control cabinet are housed in a steel box section. The 109-kv Thyrite lightning arresters are mounted on standard brackets and have their upper ends braced to the top of each of the three high-tension bushings, thereby eliminating the usual bracing insulators.

For synchronizing purposes each transformer is equipped with one 35-va bushing potential device. There are four full capacity taps in the high-tension winding. These transformers are capable of delivering their full rated capacity for a period approximately one hour if a power failure occurs to all of the three cooling units during a period of full capacity operation. The time element is governed by ambient temperature. Upon energizing the transformer, one heat exchanger unit is automatically started and the other two are controlled by thermostats. With low ambient temperature the transformers could be energized and delivering load for a considerable length of time without a cooling unit operating. Actually, during winter temperature conditions the transformers have delivered their full rated capacity with only one cooler unit operating, the thermometers indicating no appreciable temperature rise.

Two sources of 220-v 3-phase auxiliary power supply for the cooling units are provided; with each transformer having a manually operated transfer switch on the control panel. The usual temperature indicators and alarm devices are also provided.

Adjacent to each transformer is mounted a 3000-amp 1½ million kva 15-kv electrically operated oil circuit breaker equipped with 34.5-kv bushings, identical with those installed on the low-tension side of the transformer. These breakers are used to switch the generator onto the system and provide for overall automatic clearing of faults for each of the transformer banks.

Energizing and de-energizing of the high tension side of each transformer by a motor-operated airbreak switch has proved surprisingly successful.

The capacity of the station auxiliary transformer was made ample, thereby providing for all auxiliaries of this unit as well as the possibility of supplying part of the auxiliaries of the older units. The dependability of three-phase transformers and the adoption of a self-cooled unit has simplified external electrical and mechanical connections.

Motors

All motors larger than 50-hp, with the exception of flood pumps, are fed from the 2300-v station service cubicles. Motors 50-hp and smaller are fed from the 440-v Cabinetrols.

All motors supplied from the 2300-v service are constant-speed, squirrel-cage induction and are connected for across-the-line starting. The largest of the 2300-v motors is rated 1750-hp at 3,600

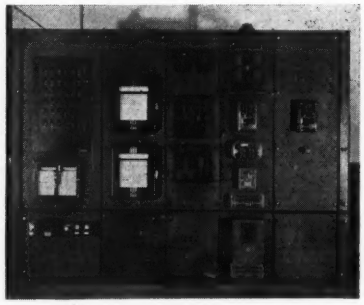


Fig. 4. Station annunciator, generator totalizing and voltage regulator panel

rpm and drives one of the boiler feed pumps. Due to the difficulties encountered in obtaining equipment and materials at the time this 1750-hp motor was taken from a steam-electric driven boiler feed pump in the older part of the station.

Two additional boiler feed pumps are each driven by 1400-hp 3600-rpm General Electric motors. These particular motors were purchased from the Sun Oil Co. and completely reconditioned by the General Electric Co.

The induced draft fan, forced draft fan, pulverizer and booster pump motors are all 2200-v rating and range in capacity from 100-hp to 700-hp. The condensate, circulating water and boiler feed pumps are also driven by 2200-v induction motors. The service water, gland and bearing water pumps are driven by 440-v squirrel-cage induction motors.

Controls

Control of this unit had to be properly coordinated with those of existing units. The main generator switchboard controls were placed on the existing benchboard and adjacent to the other six units. This entailed a considerable change in existing controls of transformer banks, 132-kv circuits, totalizing metering, regulators, synchronizing facilities, etc. The use of an electronic exciter on one of the existing units for its preliminary operation, with provision for future permanent use on No. 7 Unit. also required numerous changes in controls.

Auxiliary Controls

The station auxiliary transformer supplies energy to both the 'A' and 'B' auxiliary buses through automatic air breakers. These buses may be tied to and operated with corresponding buses in the old station; however, the limited capacity of the breakers in the older section prevents power being delivered from the No. 7 auxiliary transformer until such time as reactors can be connected in the circuits. The new buses are energized from the older station auxiliary buses for the initial starting of No. 7 station auxiliaries. This operation is for only a limited length of time. Automatic reclosing facilities are provided on the following schedule: should the No. 7 Unit auxiliary transformer be cleared by differential relays, the 'A' and 'B' auxiliary bus feed will be automatically transferred to the old station buses. However, if either of the No. 7 'A' or 'B' bus breakers clear to the auxiliary bank by an overload bus protection operation, only one reclosing operation of the transformer breakers will be made.

Auxiliary Feeders

Each of the auxiliary feeders such as pumps, transformers, etc., has only one breaker and one source of power. This is made possible by the installation of an extra or spare auxiliary unit. All 2300-v auxiliaries are controlled by type 50-DH-150—1200 amp 150,000 kva 5-kv Deion air breakers. The transformer bank, bus tie and bus sectionalizing breakers have a 200 amp rating. These breakers are controlled from the main control room. The individual feeders are controlled from the switchboards on the boiler and turbine operating floors and by push buttons adjacent to the motors when they are remote from the operating area.

The 440-v auxiliaries are supplied from two 300-v auxiliary circuits fed from the 'A' and 'B' buses through an I.T.E. cubicle.

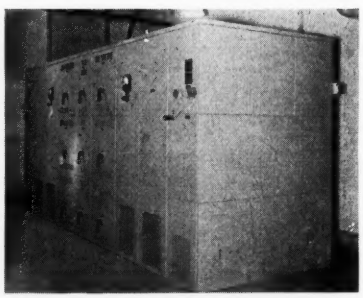


Fig. 5. A 440-v station auxiliary group center

PRINCIPAL ELECTRICAL EQUIPMENT, Springdale Power Station, New 80,000-kw Unit, West Penn Power Co., Pittsburgh, Pa.

Main Unit Generator Westinghouse Electric Corp. 81,250 kva—65,000 kv at 0.8 p.f.—11,500 v, 3750 amp, 3-phase, 60-cycles, 3600-rpm 0.9 short circuit ratio—Hydrogen cooled with hydrogen pressure of ½ psig, if hydrogen pressure increased to 15 psig, generator capacity is increased to 93,440 kva.
Two speed turning gear driven by two 440-v 3-phase motors, one turning unit at 3 rpm through one gear train and second for turning unit at 30 rpm through second gear train.

Cables—Main Generator & Power Kerite Insulated Wire & Cable Co. Habirshaw Wire & Cable Co. American Steel & Wire Co.
Generator is connected to each of the main transformers by means of six 2 million C.M. spiral core cottonwrap conductors insulated with 24/64" Kerite compound with metal tape and asbestos braid. Kerite triplex cable has also been generally used for other power and control circuits. Also triplex high temperature varnished cambric tape and asbestos brain conductors.

Cable Supports Johns-Manville and Unistrut Products Co.
Transite trays supported by Unistrut type steel supporting members. Generator cables supported on ebonywood cleats on fabricated steel structures.

Passenger Elevator Westinghouse Electric Elevator Co.
2000 lb capacity—200 ft per min speed. Variable voltage operation, single-party push button control. Additional station at each landing for emergency control.

Field Discharge Unit Westinghouse Electric Corp.
Copper oxide field discharge unit, 250 v continuous duty, 350 v short periods, 1000 amp discharge with maximum ceiling voltage of 750 developed across the generator field.

Lighting Cabinets Penn Electrical Co.
Six lightings each containing 2-section panels controlling normal and emergency lighting circuits through single pole 35 A Heinemann magnetic trip switches.

General Lighting Goodrich Co.
100-500-w type RLM dome and shallow dome disconnecting hood style reflectors.

Turbine Room Lighting Holophane Co.
Special high bay 1000-1500-v units with aluminum covers.

MOTORS

Booster Pumps Elliott Co.
Three 400-hp 1800-rpm, 3-phase 2300-v 40-c rise drip-proof squirrel cage induction type motors, direct-connected to Allis-Chalmers booster pumps.

Boiler Feed Pumps Westinghouse Electric Corp.
One 1750-hp, 3600-rpm squirrel cage type totally enclosed, 3-phase, 2300-v motor direct-connected to a Byron Jackson boiler feed pump. General Electric Co.
Two 1400-hp, 3600-rpm 2200-v 3-phase squirrel cage induction motors each directly connected to a Byron Jackson boiler feed pump.

Circulating Pump Westinghouse Electric Corp.
Two 250-hp, 435-rpm squirrel-cage, 2200-v 3-phase, vertical type, directly connected to Westinghouse circulating pumps.

Condensate Pump Westinghouse Electric Corp.
Two 200-hp, 1200-rpm, 3-phase horizontal type, directly connected to Westinghouse condensate pumps.

Forced Draft Fan Motors Elliott Co.
Two 400-hp, 1170-rpm 3-phase, 200-v 40-c rise and 60-c ambient, Class 'B' insulation, directly connected to Sturtevant forced-draft fans.

Induced Draft Fan Motors Elliott Co.
Two 700-hp, 720-rpm, 3-phase, 2200-v 40-c rise, 60-c ambient, Class 'B' insulation, induction type, directly connected to Sturtevant induced-draft fan.

Miscellaneous Motors Allis-Chalmers, Elliott, General Electric and Westinghouse.
For the service water, ash handling, bilge and sump, boiler fill etc. All motors above 50-hp with the exception of four 75-hp units, are supplied from the 2300-v system. These four and all motors of 50 hp and below with the exception of some very small sizes are supplied from the 440 v system.

Fly Ash Precipitator Research Corp.
Electrostatic Cottrell Precipitator of the wire and perforated plate electrode type. Guaranteed to remove 95 per cent of suspended matter from the flue gases. The rated gas capacity is 400,000 cfm of gas at the inlet, at gas temp of 325 F and a gas press not to exceed ± 20 in. H_2O.

Generator Neutral Resistor Westinghouse Electric Corp.

SWITCHES

Oil Breaker—Main Transformer, 11 kv General Electric Co.
Two 15-kv, 3000-amp, 3-pole solenoid-operated outdoor-type oil circuit breakers with 34.5-kv bushings; interrupting rating 1½ million kva.

Main Transformer—11-KV Oil Breaker Discs Railway & Industrial Engineering Co.
Two 34.5-kv 3000-a. type TTR, 3-pole manually-operated, gang-controlled, outdoor disconnecting switches for vertical mounting with Kirk interlocks.

Main Transformer Banks—132-KV Air Switches Railway & Industrial Engineering Co.
161-kv, 600-a. type TTR5, 3-pole, single-throw, vertical, motor-operated, gang-controlled airbreak switches for horizontal upright mounting on 16 ft phase spacing, equipped with manual gang-operated grounding switch and Kirk interlocked.

Station Auxiliaries Transformer Disconnects Westinghouse Electric Corp.
15-kv, 3000-a, 3-pole, single-throw, gang-controlled Kirk interlocked, manually-operated load break disconnect switch.

Generator Neutral Railway & Industrial Engineering Co.
23-kv, 1200-a single-pole, single-throw manually-controlled disconnect switch.

SWITCHBOARDS

Main Control Room Westinghouse Electric Corp.

Turbine Pump and Heater Control Empire Switchboard Co.

Boiler Room Empire Switchboard Co.

Generator Field Control Westinghouse Electric Corp.
One double-compartment cubicle, each enclosing one 1200-a, type DA-50 Deion circuit breaker electrically operated.

Hydrogen Control Westinghouse Electric Corp.
Instruments indicating hydrogen density and pressure; signals and alarms for the generator hydrogen equipment.

SWITCHGEAR

2300-v Auxiliaries Westinghouse Electric Corp.
Two bus sections; a total of 29 metal-clad switchgear units, type 50DH150 Deion circuit breakers with current transformers, buses, instruments, control switches and testing facilities.

Power Distribution—440-v Local Service Penn Electrical Co.
Three distribution cabinets each housing about 10—3-phase, 440-v Trumbull Converti fuses of various capacities.

Power Distribution—250-v DC Penn Electrical Co.
Several cabinets housing Trumbull Converti fuses of various capacities.

Pulverizer Mill and Auxiliaries Westinghouse Electric Corp.
Five steel cubicle units each enclosing Westinghouse type LCB load-break disconnecting switches, current transformers and 1½-kva, 2300-230-v dry type transformers. Located adjacent to each respective motor unit.

Boiler Fill and Ash Handling Westinghouse Electric Corp.
Two steel cubicles each housing two type LCB, load-break disconnect switches, current transformers.

440-v Auxiliaries I.T.E. Circuit Breaker Co.
One metal enclosed unit type substation consisting of two 450-kva, 2500 to 480-v 3-phase, 60-cycle indoor type 80-C. rise delta-delta Pennsylvania transformers, each having its primary controlled by one R & I E 400-a. 5-kv interrupter disconnecting switch. The 440-v circuits are controlled by I.T.E. type KC, 3-pole switches.

Lighting Distribution Center Penn Electrical Co.
One totally-enclosed steel cubicle housing two 150-kva, single-phase, 2300 to 230-115-v air-cooled Pennsylvania transformers. High tension side of each controlled by a Westinghouse, type LCB, 2-pole, 600-a, 7500-v Deion load break disconnect switch. Low tension side controlled by double-throw knife switches. Feeders controlled by I.T.E. type ET automatic circuit breakers. Two Automatic Switch Co., automatic transfer switches for main feed to emergency lighting circuits.

440-v Motor Control General Electric Co.
Three Cabinetrol 440-v motor and auxiliary control centers each housing approximately 30 type CR Trumbull combination starters each equipped thermal overload protection and Trumbull snap action fused switches for short circuit protection; visual circuit opening to meet maintenance safety requirements. These centers are in turbine room basement, boiler room and auxiliary bay.

Valve Control Penn Electrical Co.
Four distribution cabinets each having approximately 10 compartments housing 2-pole Trumbull fuse units and Westinghouse type reversing contactors, with thermal overload elements, to control various motor-operated valves.

Telephones The Bell Telephone Co. of Pennsylvania

Main Transformers—Power No. 73 & 74 General Electric Co.
Two 45,000-kva, 3-phase, 60-cycle 55-C forced-oil and forced-air-cooled 132-kv grounded Y and 11 KV delta, outdoor, complete with three unit type detachable coolers, bushing type current transformers, nitrogen gas sealed and protected by 109-kv Thyrite type arresters mounted on each transformer.

Main Transformer Cooling Transformers Pennsylvania Transformer Co.
Two 50-kva, 3-phase, 60-cycle, 460- to 230-v delta-delta dry type transformers, 55-C rise.

Station Auxiliaries Transformer Allis-Chalmers Mfg. Co.
One 7500-kva, 3-phase, 60-cycle oil-insulated, self-cooled outdoor type, 11,500-v delta with high voltage taps and 2300-v delta. Sealed inertaire gas equipped with 34-kv and 15-kv bushings on high and low tension side.

Generator Neutral Grounding Transformer Westinghouse Electric Corp.
150-kva, 12,000- to 480-v single-phase, indoor dry type transformer.

LOW-TEMPERATURE RESEARCH

THE HELIUM CRYOSTAT is one of the recent developments in low-temperature research. Interest in this research has increased greatly in recent years and promises to become even more widespread, following the development by Professor S. C. Collins of MIT of a relatively simple apparatus which makes readily available any temperature down to 2 deg absolute or —457 F. At extremely low temperature, much can be learned about the solid state of matter. In the range near absolute zero or about —459.4 F, the minute internal influences inside the molecules of matter become the governing influences. At ordinary temperatures these minute influences are obscured by the relatively large thermal motion of the molecule, but at absolute zero there is virtually no thermal motion. The molecules are literally frozen in their tracks and their properties can be more readily examined and more accurately measured. The new device known as the Helium Cryostat operates by circulating gaseous helium at moderate pressure through a heat exchanger and then expanding it through an engine where it does work. Consequently more heat is removed from the helium than if it were expanded in the conventional manner through an orifice. By constantly circulating the helium, cooling it in the heat exchanger with the cooler helium from the engine exhaust, any heat leakage due to imperfect insulation or the experiment itself may be counteracted. As contrasted with the tons of special equipment at pressures up to 3000 psi to produce liquid helium by other methods now in use, the present device weighs approximately one-half ton, of which three-quarters is the compressor and drive, and it operates at only 200 psi. Perhaps, says the *Industrial Bulletin,* a better knowledge of the characteristics of molecules and atoms through low temperature research will bring us closer to many of the theoretical goals we seek.

Coal Preparation and Burning Discussed by ASME—AIME

Preparation and use of anthracite given prominence at joint meeting held in Philadelphia. . . . Results of investigation conducted to determine best methods of dealing with cinders and fly ash when using anthracite on traveling grates were reported. . . . Experiences with pulverized anthracite related. . . . Prepared coal sizes discussed

PHILADELPHIA engineers were hosts to the Fuels Division of the American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers during their ninth combined meeting held in the Bellevue-Stratford Hotel on October 24 and 25. This two day meeting was attended by nearly 300 engineers interested in the preparation, marketing and use of coal.

Listed in the tabulation are the subjects and authors of all the papers presented during the meeting. Of these papers only two and a panel discussion on coal sizes were of direct interest to power engineers and are given here in short abstract for the benefit of readers.

Burning Anthracite on Chain Grates

C. S. Gladden, Superintendent of Power of the Heyden Chemical Corp., Morgantown Ordnance Works, in his paper under the title Cinder and Fly-Ash Factors When Burning Small Anthracite Coal on Traveling Grate Stokers, presented test data, concerning the quantities and characteristics of cinders and fly ash, which result when burning small sizes of anthracite on traveling grate stokers; distribution of precipitation of cinders and fly ash at various collection locations in the path of the furnace gases from the boiler to the stack; influence of fines in the coal on the quantity of cinders and fly ash produced; description of an efficient method of recirculation of cinders and fly ash; and economies to be expected by recirculating and reburning cinders and fly ash.

"The fly-ash problem," he stated, "exists whether the fuel is burned in solid or in pulverized form. A recognized method of burning small sizes of anthracite is on traveling-grate stokers with grates designed to prevent excessive sifting of the fine coal. This requires a limited percentage of air space between the 'keys' or grate bars, and zone-controlled forced draft. In burning the finer sizes of anthracite on stokers of this design, the cinders and fly ash from the stack present some factors of economic loss and of nuisance from material from the stacks being deposited on surrounding areas. The cinder and fly-ash factors increase as the percentage of fines in the coal increases and as the rate of combustion is extended.

"Various methods of cinder and fly-ash disposal are in common use. In a few cases of the larger industrial and utility installations, an effective mechanical fly-ash collector is installed between the boiler outlet and the stack. Many industrial units, however, do not take this precaution unless induced to do so by local conditions. The fly ash and cinders which first precipitate out of the gases in the early passes of the boiler, as a rule, contain more carbon and are coarser than the fly ash which is precipitated from the last pass of the boiler or from the base of the stack. It is important that the cinders from the first stages of precipitation be collected and burned for economical reasons. The methods in general use divide into several classes as follows:

1. Cinder hoppers in the boiler setting are connected with the furnace by an open chute or pipe directly through the roof of the rear extended arch. This arrangement results in the cinders being held back by the upward back draft from the furnace until they collect in sufficient quantities on the sloping sides of the cinder hoppers to avalanche and slide through the opening against the back draft.

2. Cinders and fly ash are continuously or intermittently removed from the hoppers and are returned to the furnace by means of a pneumatic conveyor or other device.

3. Cinders and fly ash are continuously or intermittently removed from the hoppers and are mixed with the regular fuel entering the furnace.

Effect of Returning Cinders to Furnace

"When the cinders are returned for recirculation and reburning, the boiler-furnace gases will carry not only the normal production of cinders but also the cinders that are recirculated. However, the recirculated cinders are so rapidly consumed that the cinder and fly-ash loading of the furnace gases does not become excessive.

"The relative quantities and fineness of the cinders precipitated at the different collection locations is of interest. In general the cinders at each location become coarser as the combustion rate increases, and the percentages of the finer material increase progressively as the cinder-collecting hoppers approach the stack.

"The economic loss of the carbon accompanying the ash becomes excessive when the combustion rates exceed 25 lb per sq ft of grate per hr. This loss of carbon at the higher combustion rates presents the problem of further recirculation of escaping carbon. There are several commercial fly-ash collectors which may be introduced between the boiler and the stack which will effectively reduce the carbon loss to a negligible amount. The induced-draft fans require regular maintenance attention due to cinder and fly-ash erosion. The fan maintenance costs as well as the value of the carbon loss will usually justify a further investigation of the installation of the specially designed fly-ash collectors.

"The principle of introducing continuously the heated cinders into the forward-moving furnace gases under the rear arch surrounded with heated air to support combustion has proved very successful. The furnace design with the front ignition arch and extended rear arch is typical of modern design for burning small sizes of anthracite on traveling-grate stokers. In a furnace of this design, the carbon in the cinders is consumed mostly in suspension as it passes through the hottest and most active regions of the furnace. It can readily be observed through the side doors that the small cinders immediately

Papers Presented at Ninth Fuels Meeting of ASME and AIME

FINE COAL CLEANING IN THE NETHERLANDS, by M. G. Driessen, Chief, Mining Research Department, Staatsmijnen, Lumberg, Netherlands.

PRELIMINARY TEST OF DUTCH CYCLONE COAL WASHER, by H. F. Yancey, Supervising Eng. Northwest Exp. Station, U. S. Bureau of Mines and M. R. Greer.

COMBUSTION OF ANTHRACITE IN GLASS TUBES, by R. C. Johnson, Vice President, Anthracite Institute.

BURNING ANTHRACITE ON CHAIN GRATES, by C. S. Gladden, Departmental Engr., Cherokee Ordinance Works, Hayden Chemical Corp.

GRINDING OF ANTHRACITE FOR PULVERIZED FUEL, by C. H. Frick, Plant Betterment Engr., Power & Light Co., Allentown.

SHUTTLE CAR HAULAGE, by D. R. Mitchell, Head, Dept. of Mineral Engrg., Pennsylvania State College, with William Bellano, R. D. Ash and John D. Morgan, Jr.

NEWKIRK TUNNEL MINING PRACTICES, by G. A. Roos, Manager, Philadelphia & Reading Coal & Iron Co.

MODERN HAULAGE TO MEET LOCAL CONDITIONS, by G. Stuart Jenkins, Asst. Gen. Mgr., Consolidated Coal Co.

flash into flame and the larger cinders may be seen to fall forward on the grate or be guided upward into the throat of the furnace with the furnace gases. It is probable that the larger cinders pass through the furnace several times before finally being consumed."

Pulverizing Anthracite

As a preface to his paper entitled "Grinding of Anthracite for Pulverized Fuel," C. H. Frick, Plant Betterment Engineer of the Pennsylvania Power and Light Co., gave some of the high-spot history of the anthracite industry leading up to the first use of pulverized anthracite which took place at the Lytle power plant of the Susquehanna Collieries Co. in 1918. A second and larger plant was installed by the same company in 1921 which contained six 500 hp and six 600 hp boilers, and was later purchased by the Pennsylvania Power and Light Co.

The anthracite used in these plants was smaller than No. 3 buckwheat, and was known as slush, about 70 per cent of which passed through a 3/64 in. round hole screen. This material was the discharge from the nearby breakers, so small in size as to be unmarketable. It was dried and ground to a fineness of about 82 per cent through a 200-mesh screen. This coal contained about 8 per cent volatile matter and burned very satisfactorily in the furnace designed for it.

In the summer of 1924 a series of tests was conducted which demonstrated that anthracite from any location could be satisfactorily ground and burned, and as a result the Pennsylvania Power and Light Co. decided to enlarge its Pine Grove plant and to install therein three pulverizing mills each of 70-in. diameter.

Experience with this installation was so satisfactory that pulverizing equipment was put into service in the Hauto plant during the summer of 1943. The preparation plant consists of two cylindrical rotating driers, each 60 ft long by 7 ft 6 in. in diameter and having a rating of 30 tons per hour at normal speed, from initial moisture of 20 per cent (10 per cent ice and 10 per cent water) to a final moisture of 1 per cent, and three horizontal ball and tube mills, each with a ball charge of 37½ tons when grinding coal with a moisture content of 1 per cent to a fineness of 85 per cent through a 200-mesh screen.

Anthracite, it was stated, does not behave like bituminous coal or other materials that are ground with a vertical mill, in that the coefficient of friction between the various particles is very low, the particles having a tendency to slide on each other and slide off the ball race, whereas with the horizontal mill many tons of small balls are raised by the rotation of the mill and dropped, causing thousands of hammer blows, which crush the coal to the desired fineness. In vertical mills, the few balls, usually 12 or 15 in. in diameter, tend to slide and lose their roundness, making necessary frequent replacement and high maintenance costs, whereas in the ball and tube mill the small balls, generally 1¼ to 1½ in. in diameter wear down to almost nothing, and addition is made periodically of new balls to maintain a certain level in the mill in order to maintain capacity.

Experience of the company indicated that the maintenance cost of the vertical type of mill was 41 cents per ton while that of the horizontal ball and tube type was 8 cents per ton.

It was reported that the new Sunbury plant, now under construction, will depend upon mill drying of anthracite, but for constant flow of coal to boilers, when anthracite is extremely wet, will use some bituminous coal with the anthracite.

Coal Sizes

In a panel discussion of the question "Why so many sizes of coal?" it developed that the coal industry has been attempting to meet the desires of all customers by providing each individual with the best suited to his needs. The coal industry is of the opinion that, although there are nearly 20 sizes now on the market, the needs of consumers can be met practically by six group sizes ranging from lump down to screenings.

Among the reasons for the large number of sizes are: the varying requirements of the customer's coal handling and burning equipment; prevailing load conditions on plant; price differential; segregation characteristics; cleanliness; characteristics of individual coals; fly ash and carbon carry-over characteristics; fuel using equipment competition; competition between coal producers; customer prejudices; competition among coal salesmen; functioning of the law of supply and demand.

Some progress is being made toward the reduction of the number of sizes of coal and the coal industry is soliciting the co-operation of equipment manufacturers to develop coal burners that will use a minimum number of coal sizes that can become standards of the industry.

One of the interesting features of the meeting was the address given by Charles F. Wagner of the Westinghouse Electric Corp. at the banquet on the economic possibilities of the nuclear power plant. His study of the problem indicates that nuclear-energy is quite likely to become commercial, that the cost will not be excessive but neither is it likely to revolutionize power costs, and very importantly that numerous large technical difficulties must be resolved—probably by years of development—before a commercial nuclear-energy power plant can be established.

Ninth Meeting of Fuels Division
The American Society of Mechanical Engineers
and Coal Division
The American Institute of Mining and
Metallurgical Engineers
October 24-25-1946
Bellevue Stratford Hotel, Philadelphia, Penna.

NEW ENGINEERING BOOKS

Applied Nuclear Physics, by Ernest Pollard and William L. Davidson, Jr. 249 pages, 76 illustrations, 6 by 9 inches, cloth, published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1942, price $3.00.

The world-wide interest in nuclear physics since the dropping of the atomic bombs on Hiroshima and Nagasaki last August, has resulted in the republication of many books and treatises on nuclear physics that had been available before 1942. Most of these books published prior to 1942, however, are of such a scientific and technical nature that they are difficult to understand by those who have no previous knowledge of the subject. It is for this reason that this little book by Pollard and Davidson is so welcome. It was first published in 1942, but it is still one of the best books ever published on nuclear physics that the average person with no previous knowledge of the subject can understand.

The book discusses in informal language the essential theory behind the atomic bomb. Nuclear processes and reactions, the separation of uranium isotopes by the three most successful methods—that is, mass spectrograph, thermal diffusion and exchange reaction. Finally it discusses the mechanism of uranium fission. Thus in one small volume are all the necessary topics that must be mastered for a proper understanding of the principles involved.

The aim of the authors has been to present the essential facts and methods of artificial radioactivity and transmutation in such a way as to be of service to the growing army of chemists, biologists, physicians and engineers, who, though not necessarily versed in the language of physics, are using the products of nuclear physics to further their ends in their own spheres.

The authors are well qualified to write this book. Ernest Pollard is associate professor of physics at Yale University, and William L. Davidson is research physicist at the B. F. Goodrich Company. The book is essentially a book to be read not necessarily for reference. The authors have eliminated such things as complete tables of references which would have necessitated a much larger work than the one they published. We can recommend this book very highly to anyone interested in the general subject of nuclear physics.

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Refrigeration Applications, by American Society of Refrigerating Engineers; 2d Edition, 800 pages, illustrated, 6½ by 9 in., cloth; ASRE, 40 West 41st St., New York. Price $5.00.

Completely revised and, in some cases, re-written, this volume of the Refrigerating Data Book dealing with refrigeration applications, takes advantage of the knowledge gained during the war of new refrigeration applications and additional knowledge of those that are older and better known.

Covering practically the entire application field of refrigeration and air conditioning, the book brings together for the first time in one volume, comprehensive and authoritative information adapted for the salesman or the design, installation and service engineer.

Each chapter begins with the fundamental principles involved, describes the processes employed, with suggested values to be obtained. Applications ranging from bakeries, breweries and buttermaking to skating rinks, stratochambers and wine making are included in the list.

The material in the Data Book has been divided into eight general classifications, such as frozen foods; cold storage; food manufacture and distribution; and air conditioning.

In the Classified Section will be found a comprehensive list of refrigeration equipment products and the companies that manufacture them. Another feature, not generally found in directories of this kind, is an extensive list of manufacturers of component parts and accessories of refrigeration systems, extending from automatic valves, bearings and bushings to water valves, weatherstrips and welding electrodes.

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Units of Weights and Measures, by Walter Renton Ingalls; 49 pages, size 5 by 8 in., paper cover, American Institute of Weights and Measures, 33 Rector Street, New York 6, N. Y. Price $1.00.

This bulletin gives a detailed explanation of the various units of the English system of weights and measures in practical use. These include not only common units such as the barrel, the board foot and the bushel, but a number of units met with only in rather special applications. For example, the carboy, the cental, the quintal, rod, pole and perch; etc. One of the objects of the book is to point out that while the American Institute of Weights and Measures does not oppose propaganda towards making use of the metric system in the United States of America, in the same way that it has been made compulsory in some other countries of the world, it does not oppose the use of the metric system by anyone who finds advantage in using it. The Institute believes that the English system of weights and measures is superior in usefulness to the French and the comments given on the various units are made with that in mind.

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High Vacuum Technique, by J. Yarwood; Second Edition—revised; 140 pages, illustrated; size 6 by 9 inches; cloth; John Wiley & Sons, Inc., 440 Fourth Avenue, New York City. Price $2.75.

The author's purpose in this book is to introduce the latest developments in apparatus used for production of high vacuum, to describe important industrial processes hitherto only discussed in scientific periodicals and to bring together in one volume the diverse facts about the relevant properties and uses of material encountered in all types of vacuum work.

In revising the book for this second edition, new sections have been included dealing with the performance of vacuum pumps, construction of vacuum systems and methods of measuring low pressures and pumping speed. Also the discussion of the oil diffusion pump, gas-filled tubes, and the properties of materials have been increased in size and rearranged. Twenty-six new diagrams appear in this edition, also a bibliography.

The subject is treated in the following chapters: 1. The Production of High Vacua; 2. The Measurement of High Vacua; 3. The Measurement of Pumping Speed; 4. Degassing and "Gettering;" 5. The Applications of High Vacua in Industry; 6. The Properties of Materials Important in High Vacuum Technique. Useful electronic data are included and the book is well indexed.

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Audels Power Plant Engineers Guide by Frank D. Graham. Copyright, 1945; 5 by 6¾ in.; 1500 pages; flexible simulated leather cover; published by Theo. Audel & Co., 49 West 23rd St., New York 10, N. Y. Price $4.00.

This handbook in question and answer form was written to include in one volume the complete library of practical and theoretical steam engineering. The book is divided into 65 chapters and the information it contains will be found of great value to operating engineers, firemen, water tenders, or students preparing to take examinations for all grades of engineer's license. It covers theory, construction and operation of power house machinery, including steam engines, steam boilers, turbines, auxiliary equipment of all types installed in the modern power plant. An extremely convenient feature of the guide is the comprehensive index which lists every item treated in the book both directly, indirectly and through cross references. From the basic principles down to the minutest details of construction of power equipment, instruments and devices of all types, the book is extremely complete and clear in its answers, brief and to the point throughout, making it a very helpful piece of literature for power plant operators.

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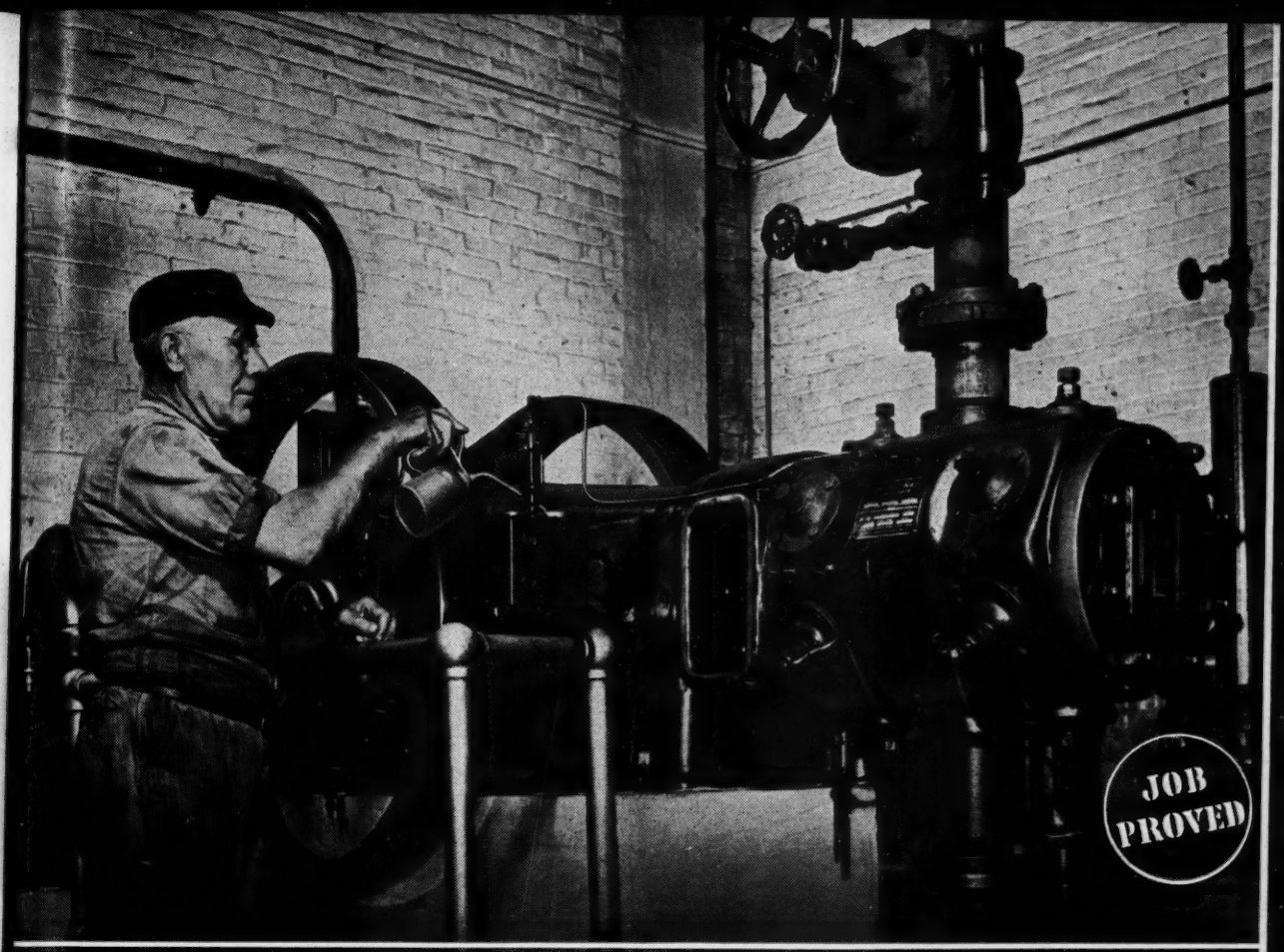
Thermodynamic Properties of Air, by Joseph H. Keenan and Joseph Kaye; 72 pages, size 7½ by 10 in., cloth; John Wiley & Sons, Inc., 440 Fourth Avenue, New York. Price $2.25.

His volume on the Thermodynamic Properties of Steam in 1936 made the work of Professor Keenan and his collaborator, Frederick G. Keyes, the authoritative basis for analytical work in the steam power field since that time. Now, in this new book, he and another collaborator Joseph Kaye, have presented data on Thermodynamic Properties of Air that promise to be equally authoritative.

The new data on air result from the latest methods of research in physical properties which give data superseding the earlier measurements by calorimetric methods. The book consists of tabulations of data which should prove of the greatest value in practical engineering calculations, such as those for heating air in a regenerator.



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Doubles Life of Valves and Rings in 2 Compressors, Ends Frequent Breakdowns Due to Heavy Carbon Deposits

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Heavy deposits of carbon on valves and piston rings had made maintenance of these compressors a chronic headache and expense.

A Sun Engineer recommended a "Job-Proved" Sun oil that is specially refined from low-carbon stock and widely used throughout industry for compressors of this type. With this oil the life of valves and rings doubled, and management estimated they had saved $2400 on maintenance alone.

This saving and this plant, which is now 100% lubricated by Sun, are typical of hundreds of cases where Sun Engineers and Sun "Job-Proved" products have helped to eliminate shutdowns, to cut maintenance costs, and to keep production on a continuous basis. Call the nearest Sun office for Sun "Job-Proved" service.

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or expanding air and gases from high temperatures, as in the combustion gas turbine.

Table I presents enthalpy, internal energy and constant pressure entropy of air with reference to a base temperature of 400 F absolute. Isentropic pressure and volume ratios relative to 400 F are given and the tabular intervals are 1 F from 300 F absolute to 3000 F absolute, and thence by 10 F intervals to 6500 F absolute. Table II lists the isothermal entropy change at tabular intervals of 0.01 from 1 to 10. Table III lists constant volume and constant pressure specific heat, specific heat ratio, velocity of sound and critical mass flow for the range 200 F abs to 6400 F abs and gives viscosity, thermal conductivity and Prandtl numbers. Other tables list functions of pressure ratio and polytropic exponents, four-place logarithms to base 10 and base e, also Fahrenheit and Centigrade conversion tables.

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Piping of Industrial Fuels, by Harry D. Unwin. Copyright 1946; **46 pages;** 8½ by 11 in.; paper bound; saddle stitched; published by Industrial Press, 148 Lafayette Street, New York 13, N. Y. Price $1.00.

In this monograph the author gives calculations, data and step by step instructions on the design and installation of gas, oil and gasoline piping in industrial plant projects, including fuel oil and gasoline storage. The first three chapters of the pamphlet are devoted to gas piping; applications and distribution, pipe sizing, liquefied petroleum systems. Then follow three chapters on oil piping; fuel oil and its storage, distribution and control and pipe sizing. Three chapters are then included on gasoline piping; distribution and storage, pipe sizing and control and safeguards. The reader will find this monograph very helpful in designing the piping system, and also in pointing out the dangers accompanying fluids of this type as well as in giving maintenance requirements which should be carefully considered in the care of piping systems carrying fluids of an inflammable nature.

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Statistical Methods, by George W. Snedecor, Fourth edition. Copyright 1946, 485 pages; 6 by 9 in.; cloth board binding; published by the Collegiate Press, Inc., Ames, Iowa. Price $4.50.

The author of this book has a fundamental belief that statistical methods can be used competently by scientists not especially trained in mathematics. The conditions surrounding the mathematical theorems can be set forth in terms quite readily understood by the lay reader. In the course of the development of each bit of scientific knowledge, there comes a time when the experimental techniques must be questioned. Are they adequate to furnish the demanded precision of results? In what respects need they be improved? Is the most hopeful point of attack in the laboratory methods or in the experimental material? Fortunately, the author states, statistical methods supply answers, in many cases with little or no extra labor in collecting data, provided only that slight but necessary modifications be included in the plan of the experiment. Previous editions of Statistical Methods have gained wide acceptance throughout the United States and in foreign countries, and the evident need for a work of this sort has encouraged the author to rewrite almost entirely the fourth edition which is just coming off the press and the scope has been widened so as to include the following among its several new features: Analysis of public opinion polls is introduced in extensive sampling; Methods for disproportionate sub-class members have been extended to include all those necessary for ordinary needs; Components of variance are given for the more common experimental designs; Increased reliance is placed on experimental samplings and treatment of correlation is expanded.

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Instruments and Process Control, prepared by Ralph E. Clarridge, J. S. Detwiler, George E. Heller and Richard N. Pond of the Taylor Instrument Companies, and B. Chester Delahooke of the Curriculum Laboratory. Printed in 1945 by the New York State Vocational and Practical Arts Association; 233 pages; 8½ by 10¾ in.; planographed printing; paper cover; plastic multiple ring binding; distributed by Delmar Publishers Inc., 49 Sheridan Avenue, Albany 6, New York. Price $2.75.

This book has been prepared as a manual to be of particular help to chemical engineers and those in training for work in the field of process control. It has been prepared in simple language giving basic and detailed information on industrial processes, control of operation and construction, control valves, instrument applications and installations and maintenance. Although prepared in co-operation with the Taylor Instrument Companies, it describes the details of construction and operation of nine leading companies including Bristol, Brown, Fox, Tagliabue and Taylor, Fisher Governor, Fulton Sylphon, Mason-Neilan Regulator and Moore Products Co. Of the 17 chapters in all designated as information sheets, the first eight are devoted to instruments, their definitions, theory, etc., but beginning with the ninth chapter applications are described for the various industries where control is employed. Such as, special controllers, controller applications on fractionating columns, controller applications on heat exchangers, controller applications in industrial air conditioning, etc. In Appendix I is given a Glossary of Terms and Appendix II is devoted to a treatise on Advanced Control Theory. The book closes with a complete index of the articles and subjects covered in the treatise.

• • •

Report on Behavior of Ferritic Steels at Low Temperature: Part I and Part II, by H. W. Gillett and Francis T. McGuire. Published in 1945; Part I has 56 pages, Part II has 156 pages; 8½ by 11 in.; bound separately in heavy paper cover; copies of the complete report (two parts) can be obtained from American Society for Testing Materials headquarters, 260 S. Broad St., Philadelphia 2, Pa. Price $4.00 per set.

This report is the result of the work of the War Metallurgy Committee of the National Academy of Sciences, National Research Council, Advisory to National Defense Research Committee of Office of Scientific Research and Development and Office of Production Research and Development of War Production Board. It is considered an extremely important report and has involved much time and effort in compiling, editing and publishing, particularly involving the figures and diagrams. The report was intended to secure a comprehensive set of experimental data on the low pressure behavior of commercial, national emergency, S.A.E., and similar steels. It was felt some of the points would clarify the relation of composition, heat treatment, grain size, etc., to low-temperature behavior. Much data have been included in this report from other sources and publications. This report, in a sense, is an up-to-date supplement to the 1941 book prepared by Dr. Gillett for the joint ASTM-ASME Research Committee covering properties of metals at sub-atmospheric temperatures. Part I covers the extensive data resulting from experimental work carried on at the University of Kentucky as a War Metallurgy Committee project, but there is much data from other sources. There is first an extensive discussion of the project, the materials included and the data resulting from the intensive experiments. Part II, the larger part of the report, gives the data developed with a large number of figures and charts.

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Boiler Room Questions and Answers, by Alex Higgins; first edition; 139 pages, illustrated, size 8 by 11 inches; cloth binding; McGraw-Hill Book Co., Inc., 330 West 42nd St., New York City. Price $3.00.

Good practical engineers often have difficulty in passing written examinations because of their inability to express themselves in writing. This book has been compiled to help such men overcome this handicap and to give them ,as well as others, a comprehensive review of typical examination questions on boiler-room operation, written in clear and concise language that can be readily understood by all practical power-plant operators.

One of the best parts of Mr. Higgins' book is his first chapter, very brief, but telling very accurately how the student can get the necessary information about the various boiler regulations, and showing how to study questions and answers for an examination. The following chapter deals with boiler calculations. Next come chapters on Details and Accessories; Boiler Construction; Cleaning and Inspection; Boiler Foundations and Erection; Some Typical Boiler Repairs; Some Important Fuel Facts; Fuel-gas Analysis, how to perform it and what it means; Facts about Draft; Facts about stokers, pulverized fuel, gas, oil firing and combustion; Boiler Feedwater Treatment and Heating; Heat Facts, Laws and Problems; How to Use Steam Tables; Injectors and Pumps; Pumping Problems; Pipe and Piping Accessories; and Piping Layout and Calculations. The book is indexed and the clear well-drawn illustrations are a valuable aid to understanding.

FOR TODAY'S TOUGHER JOBS, HERE'S A NEW TOUGHER MOTOR

WHERE IT'S WET Wet weather doesn't bother the new totally-enclosed Tri-Clad motor. Neither do frequent "washdowns" in food plants.

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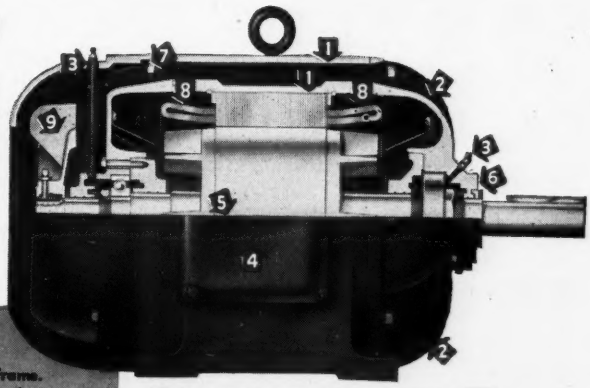
In 1940 you welcomed the Tri-Clad open motor with it's *extra protection features*. More Tri-Clads have since gone into service than any other integral-horsepower motor. Now G.E. is ready with a new line of tough, totally enclosed Tri-Clad motors for use in adverse atmospheres. *We believe they are industry's most dependable motors*. Their longer life and lower maintenance will make them a sound investment on almost every job. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



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8. Modern, "ageless" insulation treatment includes windings of *Formex magnet wire.
9. The powerful external fan is removable to simplify maintenance; nonsparking type in explosion-proof motors.
10. Individual dynamic balance of rotors and external fans protects against vibration hazards, even under severe operating conditions.

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GENERAL ELECTRIC

NEWS from THE FIELD

CHARLES A. COFFIN AWARD REINSTATED

THE CHARLES A. COFFIN AWARD, best known and most coveted distinction open to all operating companies in the electric light and power industry, has been reinstated, after a wartime suspension, according to the Edison Electric Institute, which administers the award.

The award was established 25 years ago by the Charles A. Coffin foundation to suitably recognize and honor nationally an electric company which during the year preceding had achieved the greatest advancement in its operations and physical plant, and thus made a distinguished contribution to the development of electric light and power, for the convenience of the public and the benefit of the industry.

Since its establishment, eighteen companies have received the award. No awards were made for the years 1931-1932, nor during the war years 1942-1943-1945. As a tribute to the magnificent contribution of the electric industry to the war effort, the award for 1944 was collectively bestowed on the entire industry.

N. J. PUBLIC SERVICE RADIO COMMUNICATION

THE ELECTRIC distribution department of the Public Service Electric and Gas Co. of New Jersey has completed the construction of its own two-way radio communication system by means of which the service dispatchers and other supervisors of the electric operating divisions may communicate directly with line crews, trouble men and field supervisors wherever they may be working. Any light or power customer who has trouble with his electric service and notifies the company, will find that a radio-equipped trouble car will respond even more quickly than was possible heretofore. Trouble men, repair gangs and supervisors working in the vicinity or enroute can, by means of this new communication facility, work as a team in getting the right men and equipment to the location of the damage in the shortest possible time.

Messages are sent and received at both fixed and mobile stations by means of the conventional telephone hand set. This telephone set is equipped with a "push-to-talk" button which the operator presses when he wishes to send a message. Loud speakers are also provided in the service dispatchers' and supervisors' offices and in all cars and trucks for the convenience of the operators. All transmitters are of the frequency modulated type and each has a power of 50 w.

HEATING AND VENTILATING EXPOSITION

NEW PROBLEMS in heating, ventilating and air conditioning, and new materials and methods affecting the production of equipment in the air conditioning field have combined to produce many innovations that will be seen at the 7th International Heating and Ventilating Exposition. Preparations are going ahead rapidly in plants all over the country for the display, which is to be in Lakeside Hall, Cleveland, January 27-31, next.

Specifications of the exhibits have already been received from many companies which are making ready machinery, equipment and special displays. It is being held under the auspices of the American Society of Heating and Ventilating Engineers, in conjunction with the Society's annual meeting. This information indicates that the reconversion period is bringing forth a big turnout of items suited to new requirements and based on war-time progress in manufacturing. The National Warm Air Heating and Air Conditioning Association is also meeting coincident with the Exposition.

ENGINEERING FOUNDATION RE-ELECTS KINZEL

THE ENGINEERING Foundation, at the recent annual meeting of its Board, re-elected Dr. A. B. Kinzel Chairman for the coming year. Dr. Kinzel, internationally known metallurgist, is Vice President of the Union Carbide and Carbon Research Laboratories, Inc., and of the Electro Metallurgical Co. During the war he was senior consultant of the Metals Branch of the War Production Board, and chief consultant on Metals to the Enemy Branch of the Foreign Economic Administration.

Other officers elected were Dr. L. W. Chubb, Director of the Westinghouse Research Laboratories, as vice chairman and head of the Research Procedure Committee; Dr. Edwin H. Colpitts, re-elected Director; and John H. R. Arms, re-elected Secretary. Dr. Kinzel will represent the Engineering Foundation on the Executive Board of the National Research Council.

LOW COST BUILDING DEVELOPMENT

THE H. K. FERGUSON CO., industrial engineers and builders, announced today that it has developed a modern, steel frame, fire-resistant factory building which can be built at a cost of three dollars per square foot on today's market.

The average cost of conventional and individually designed industrial structures ranges from five dollars to seven dollars per square foot at the present time.

The offsetting of current construction costs to figures more in keeping with manufacturers' capital limitations has been the goal of the company's design staff for many months, it was pointed out in the release.

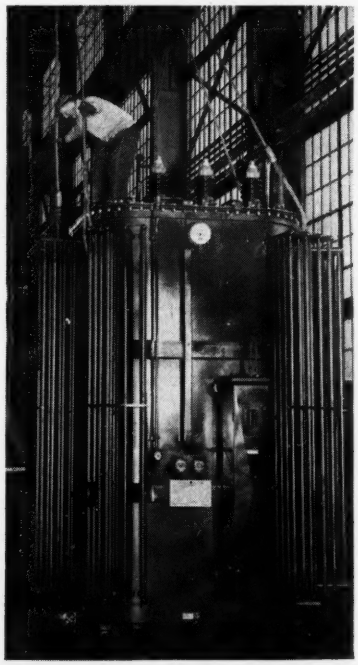
A statement by The Ferguson Co. emphasized that the low cost building is a "typical building for a typical industry."

NEW ARC WELDING FILM

"DESIGN FOR ARC WELDED STRUCTURES" is a new motion picture produced to assist architects, engineers, contractors and all people in the structural field to visualize the improvements in design and construction which are made possible by using arc welding. Directed by The Lincoln Electric Co., this color sound movie is another in the series of educational motion pictures recently completed by the world's largest manufacturer of arc welding equipment.

Humorously portraying a cave man's first attempt to join a structure with thongs, the film reviews the development of fastening methods . . . wooden pegs, then nails and as structural steel replaced wood, by bolts, nuts and rivets. Each of these methods of fastening had definite limitations but with the development of arc welding, the film shows how the designer now has unlimited freedom of design.

The film, which has a running time of approximately 15 minutes and produced by Herb Lamb Productions, is available in 16 mm. sound color prints from The Lincoln Electric Co., 12818 Coit Road, Cleveland 1, Ohio at no charge except for transportation.



Typical of the postwar transformer production from the Pittsfield Works of the General Electric Co. is this 12,000 kva autotransformer for the Modesto Irrigation District in California. This transformer, the first of three, will be used for an electrical tie between the Modesto Irrigation District and the city of San Francisco's Hetch Hetchy power line to supply additional power required by Modesto to supplement generation from their Don Pedro power house. The Modesto Irrigation District furnishes electric power to one of the richest agricultural areas in the United States. Rated at 12,000 kva, 115,000 v primary, 69,000 ground Y connected, 3 ph, 60 cycle, the units each contain 2560 gal of oil.

COMING EVENTS

Power Show—17th National Exposition of Power and Mechanical Engineering; to be held in New York City, at the Grand Central Palace, December 2 to 7.

ASME—American Society of Mechanical Engineers; mid-winter meeting, to be held December 2 to 7.

Stress Analysis—Annual meeting of the Society for Experimental Stress Analysis to be held in New York City, December 9, 10 and 11; headquarters at the Hotel New Yorker.

Heating and Ventilating Exposition—7th International Heating and Ventilating Exposition; to be held January 27 to 31 in Cleveland at Lakeside Hall.

Electrical Engineering Exposition—Annual show (Postponed since 1941) to be held in New York City, January 27 to 31; headquarters at 71st Regiment Armory, Park Ave. and 34th St.

AIEE—American Institute of Electrical Engineers; winter convention to be held January 27 to 31.

ASTM—1947 Spring Meeting and Committee Week of the American Society for Testing Materials; to be held in Philadelphia, February 24 through 28, with headquarters at the Benjamin Franklin Hotel.

Power Conference—1947 annual meeting, Midwest Power Conference; to be held March 31, April 1 and 2 in Chicago, with headquarters at the Palmer House.

ASTM—1947 Annual Meeting; to be held in Atlantic City, June 16 through 20, with headquarters at Chalfonte-Haddon Hall.

Instrument Society—Instrument Society of America annual meeting; to be held the week of September 8, 1947, with headquarters at the Stevens Hotel, Chicago.

Instrumentation Conference—Instrumentation Conference and Exhibit for 1947; to be held the week of September 8, with headquarters at the Stevens Hotel, Chicago.

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MIDWEST POWER DATES SET

THE MIDWEST Power Conference, annually the largest meeting of its kind in the nation, will be held next spring on March 31, April 1 and 2 with headquarters in the Palmer House, Chicago, it was announced this month.

Prof. Stanton E. Winston, director of the Evening Division at Illinois Institute of Technology, will serve as conference director for the eighth consecutive year. Illinois Tech will again sponsor the meeting in cooperation with nine other midwestern colleges and universities and seven engineering societies.

TOLEDO ADOPTS SMOKE LAW

THE CITY COUNCIL of Toledo, Ohio, has passed the smoke abatement ordinance prepared for it by the Coal Producers Committee for Smoke Abatement. The ordinance was written after the organization had made a comprehensive survey of the city to determine the causes and sources of smoke in that city.

The Council also announced the formation of a Sub-committee on Steamboats of the Coal Producers Committee for Smoke Abatement. The purpose of this Sub-committee is to effect smoke abatement on the steam boats plying navigable rivers before there is any thought of legislation by the various cities they reach. It is the coal industry's answer to the charge brought by its critics that it is not interested in smoke abatement.

ELECTRICAL SHOW EXHIBITS

NEWS OF EXHIBITS now being developed for the new Electrical Engineering Exposition, to be held in New York at 71st Regiment Armory next January 27-31, indicates that the display will be of exceptional interest to engineers and other visitors, opening a new channel for information and distribution in a field not hitherto serviced directly by any exposition.

For example the introduction of the electronic signal unit, amplified and relayed to control high voltages will be featured, and also many new developments in instrumentation specifically applied to the generation and distribution of electric power.

There will be a variety of insulating materials on display, including several classes of plastics, with extensive arrays of products and parts for which they are appropriate, and well presented information respecting their dielectric properties.

Especially appropriate to this Exposition will be the large group of exhibits pertaining to field work, from conductors and pole line equipment of various kinds to transformers, switch gear and many items of detail—an electronic circuit-breaker is one; another is a facsimile demonstration of a lightning arrester at work.

The important needs of maintaining service, come what may, have by no means been overlooked in planning the Exposition, and a number of exhibits will be devoted to maintenance, repair, replacement and emergency duties, from a newly developed field service truck to a long list of items for in-plant use in time of need.

VINAL NEW PRESIDENT WESTON CELL

DR. GEORGE W. VINAL, chief of the Electrochemistry Section of the National Bureau of Standards was recently elected president of the Weston Cell Committee of the International Union of Chemistry. Dr. Vinal is internationally known for his research in the field of electrochemistry, particularly for his work in the development and perfection of the silver voltameter and the standard cell which serve as standards for the international ampere and volt. Dr. Vinal is the author of the book entitled "Storage Batteries" and has contributed extensively to scientific journals in the fields of electrochemistry and batteries.

The Weston Cell Committee, consisting of scientists from the principal nations of the world, is engaged in the scientific development and perfection of the Weston Cell as an international standard of measurement of electromotive force.

UTILITY PEAK LOADS SET RECORD

ACCORDING to figures recently released by the Federal Power Commission, major electric utility system peak loads for August 1946 indicated a new record maximum of 38,366,000 kw. In resuming monthly publication of peak load information with the series "Electric Utility Systems Loads," the Commission issued two brief reports, one showing peak load and corresponding energy summaries for the first six months of 1946 and the other giving figures for July 1946. Data were given by power supply areas and for the United States as a whole.

The August peak loads totaled 2.6 per cent higher than August of last year and approximated the previous miximum of 38,252,630 kw set in January 1945. Although aggregate loads for the last quarter of 1945 were not available, it was likely they were below the August 1946 level. Corresponding energy figures for August of the current year, while totaling 4.6 per cent higher than August 1945, did not exceed several previous monthly totals.

HASTINGS NEW ASCE HEAD

EDGAR M. HASTINGS, Richmond, Va., Chief Engineer of the Richmond, Fredericksburg and Potomac Railroad Co., was nominated as the 1947 President of the American Society of Civil Engineers at the Fall Meeting of the Society's Board of Direction in Kansas City. The nomination, tantamount to election, will be confirmed by the membership, and the new head of the Society will take office at the Society's Annual Meeting in New York in January.

Glen C. Boyer, nationally-known consulting engineer, has joined the faculty of the Missouri School of Mines and Metallurgy as an associate professor of Mechanical Engineering. Mr. Boyer was an associate engineer on the staff of Burns and McDonnell Engineering Co. for 16 yr. where his professional activities included the design of Diesel and steam power plants as well as electric distribution systems in many sections of the United States.

The Committee for Economic Development has announced the resignation of C. Scott Fletcher as executive director. Mr. Fletcher has been elected president of Encyclopaedia Britannica Flms, Inc., with offices in Chicago. He will be associated with CED as a trustee and as a member of its Research and Policy Committee.

Clarence Johnson, for 18 yr research engineer for Bailey Meter Co., announces the opening of his own research consulting office on inventions and engineering developments at Beloit, Wis. Mr. Johnson has many patents on mechanical, chemical and automatic control inventions and is the author of several technical articles on the application of air and hydraulic controls to machine tools for the purpose of automatically duplicating work pieces.

Frank Mac Millen, New York newspaper man, has joined the staff of the American Standards Assn. as Director of Information, it was announced recently.

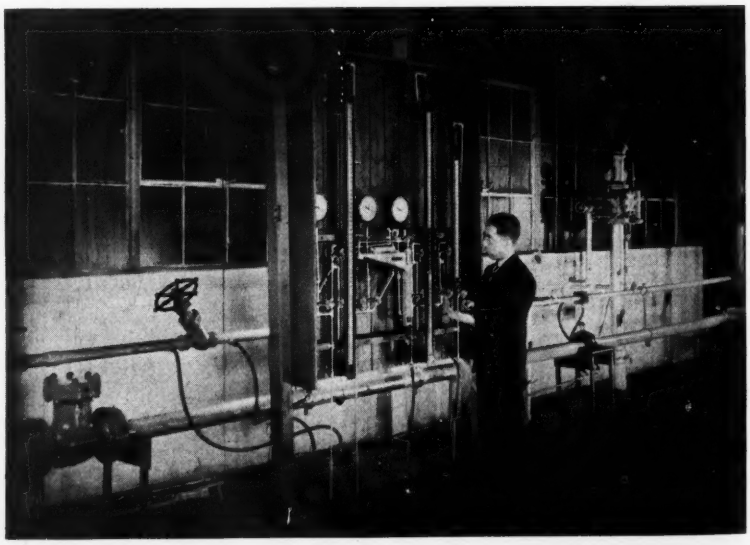
The American Society of Refrigerating Engineers has just announced the appointment of Fred C. Kelly, Jr., of New York as Editor of *Refrigerating Engineer*, the monthly journal of that Society. Since the resignation, about a year ago, of the former editor, Helen Peffer Oakley, the magazine has been published under the direction of Clifford F. Holske with the assistance of the Managing Editor, Barbara Belcher, who will continue in that capacity.

EDWARD LABORATORIES CONDUCT FLOW TESTS

AN ORIGINAL test hook-up, believed to be the only one of its kind in existence, has been constructed by the laboratories of Edward Valves, Inc., for the computation of pressure losses through valves and piping.

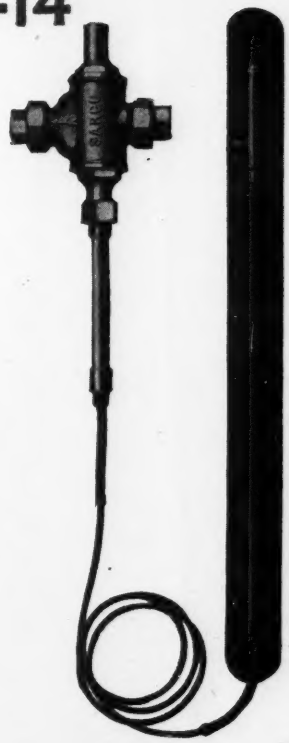
The equipment was designed and fabricated after several years of study. Provision is made, in the set-up, for tests of all types of standard valves. Readings are made on flow meters, manometers and gages, and are tabulated for specific operating conditions. From these readings, accurate computations of pressure loss for valves of known characteristics are possible for all normal service conditions.

The experimental work on pressure loss is projected as a permanent and continuous activity of the Edward laboratories. E. B. Pool, Research Engineer, directs the section of the laboratory staff assigned to the project.



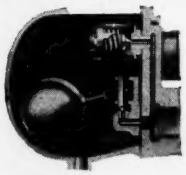
Recording instruments in flow test hook-up designed by laboratories of Edward Valves, Inc. Here, flow through Edward Fig. 2698 forged steel globe valve at left is measured with orifice type flow meters and pressure is checked with mercury manometers and gages. Tests provide data on pressure loss through valves and piping, and guide design of new types of valves

WITH SARCO KR-14 TEMPERATURE CONTROL



January or June, molasses runs freely—at exact temperatures from the main storage tank in this large food plant in Buffalo. The entire room, including incoming barrels of molasses, is heated by steam coils controlled by the Sarco KR-14 room temperature control. The coils are drained by Sarco float thermostatic steam traps.

Sarco Temperature control is the best kind of production control. It sets the quality, the quantity and the cost of your product, once and for all. It can be applied to existing jobs or specified to come as an integral part of new equipment.



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Properly selected and installed together with suitable Sarco Steam Traps, you will also benefit by a reduction in the cost of fuel wherever steam or hot water is used.

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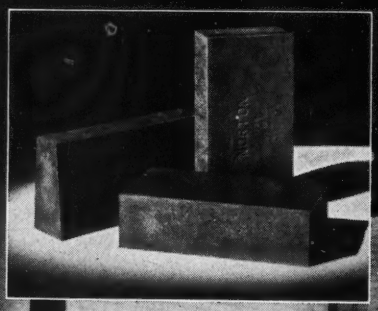
CRYSTOLON BRICK - Give to Boiler Furnaces a Refractory Lining that Stands the Gaff... Cuts Fuel and Maintenance Costs



The high refractoriness, physical ruggedness and chemical stability of Crystolon Brick plus the resistance of their hard dense surface to clinker adherence and to abrasion, provides a refractory lining for boiler furnaces which pleases the power plant operators by providing a maximum of service with a minimum of down-time for repairs. The resistance of Crystolon Brick to penetration or corrosion by slag brings economies in the way of increased operating efficiency, faster clinker removal and lower maintenance costs.

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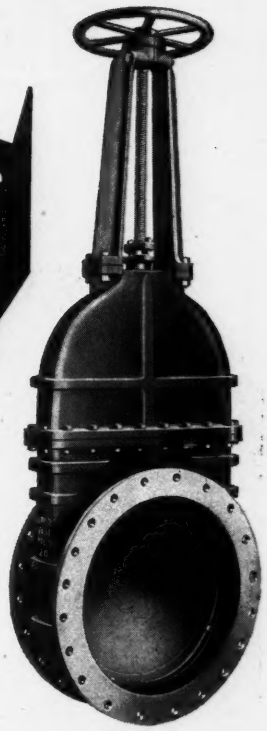
Every feature you want in

LARGE GATE VALVES

is available in the many KENNEDY DESIGNS



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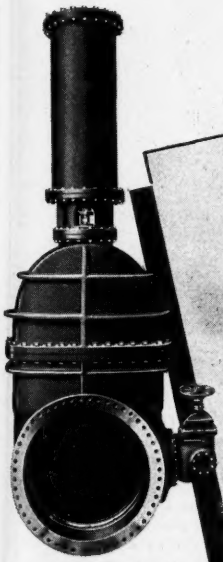
Kennedy has specialized in large valve design for almost three-quarters of a century, and many hundreds of such installations in central power generating stations, industrial plants, municipal water supply systems, and hydraulic projects all over the world have thoroughly proven the excellence of Kennedy large-valve designs.

These valves are available in sizes up to 60-inch, for pressures ranging from 25 lb. steam to high pressures for fire protection systems, with direct manual, chain wheel, gear, cylinder or electric control, and with many special accessories such as by-pass, clean-outs, square bottom, water-sealed stuffing boxes, rollers, tracks and scrapers. Write for the 240-page Kennedy Catalog which describes these valves in detail and the entire Kennedy line of valves and pipe fittings for all standard requirements.



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5. **Convenient Repacking . . .** Glands and packing are easily accessible.
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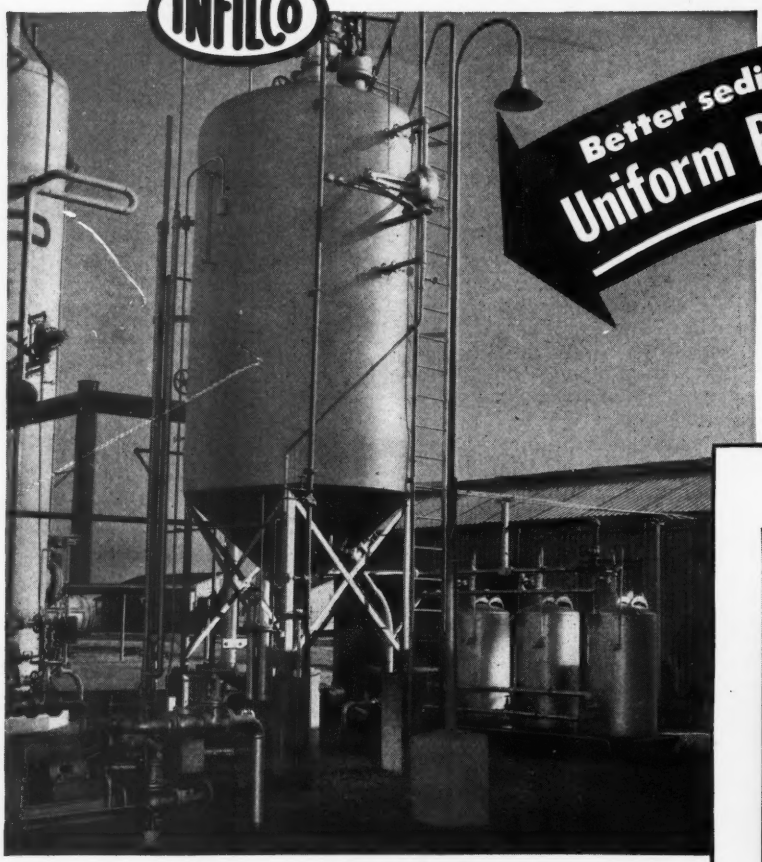
KENNEDY *valves - pipe fittings - fire hydrants*

INFILCO



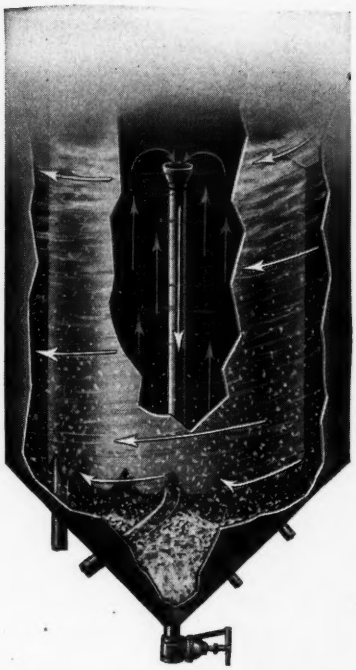
Better sedimentation produces Uniform Boiler feed water

One unit solved *three* worries at this plant . . .

Raw water at this southern refinery is the troublesome type. Not *properly* treated, it could cause hard, glassy scale, sludge and foaming. Reasons for this not-too-happy outlook are silica, hardness and high alkalinity. So in installing treating equipment, guesswork wouldn't do. These were questions for considered answers . . . from INFILCO engineers.

In this case, as in many others, proper treatment centered around *effective* reactions with selected chemicals in the sedimentation tank. Dissolved silica, hardness and alkalinity had to be reduced to harmless amounts. These objectives were established by careful analysis of the raw water, and here are the results.

Thorough mixing of heated raw water and chemicals begins in the mixing compartment of the INFILCO Sedimentation Tank. From this turbulent zone, the water flows in a quiet spiral that allows time for *complete* chemical reaction. Reaching the bottom of the tank, it flows upward, fully treated, to the settled water take-off. That sequence continues its day-in, day-out job of removing the trouble-causing elements from the water at this plant. It's one of the examples of reliable analysis and dependable performance that characterizes Hot-Flow installations the country-over. INFILCO INC., 325 West 25th Place, Chicago 16, Illinois.



It's the *internal* design that produces *better* chemical mixing, *better* solids separation and *better* sedimentation in the Hot-Flow Tank.

Unique in construction, the interior is divided into three sections. An upper section is the mixing zone. This is divided, by a stilling plate, from an outer annular compartment, which is equal in volume with a central cylindrical uptake.

Thorough mixing of chemicals and thorough sedimentation in this tank always insure an adequate volume of properly treated feed water ahead of the filters.

CONSULT INFILCO — FIRST IN WATER AND TRADE WASTE TREATMENT

WeldELLS

for example:

selective reinforcement

The bursting stresses in an elbow subjected to internal pressure are known to be greatest at the crotch or inner arc. Mathematical calculations (see formula below) show how much greater the stress is in this region of an elbow, and the calculations have been closely confirmed by experiments.

This is taken into consideration in forming WeldELLS. As shown in the sectional illustration, extra wall thickness is provided at the inner arc to offset the added stress imposed.

There is no better evidence than this of the extra lengths we have gone to in engineering WeldELLS for full strength throughout. But there are plenty of other evidences of extra operations—extra value—that are yours only in WeldELLS and other Taylor Forge fittings for pipe welding.

A number of these extra value features are listed opposite. Combined only in the fittings that "have everything", these features mean greater soundness, speed and economy when your pipe welding is done the WeldELL way.

TAYLOR FORGE & PIPE WORKS

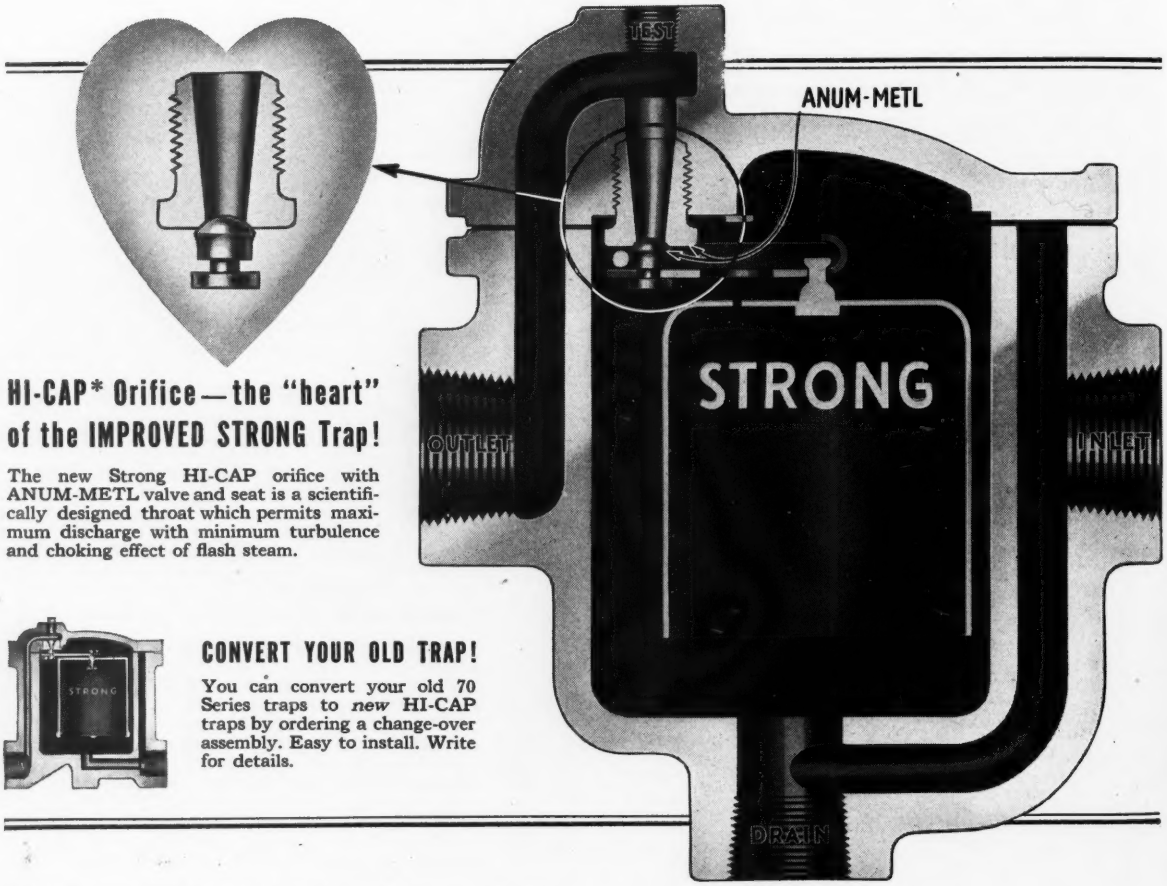
General Offices & Works: P. O. Box 485, Chicago
New York Office: 50 Church Street
Philadelphia Office: Broad Street Station Bldg.
Los Angeles Office: Oviatt Bldg.

WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

have everything

New Heart* gives STRONG Traps up to *25% Greater Capacity!*



HI-CAP* Orifice—the "heart" of the IMPROVED STRONG Trap!

The new Strong HI-CAP orifice with ANUM-METL valve and seat is a scientifically designed throat which permits maximum discharge with minimum turbulence and choking effect of flash steam.

CONVERT YOUR OLD TRAP!

You can convert your old 70 Series traps to *new* HI-CAP traps by ordering a change-over assembly. Easy to install. Write for details.

With the new HI-CAP orifice, these other new features make STRONG 70 Series traps better than ever:

- ★ Renewable seat replacing pressed-in design;
- ★ Oversize and relocated inlet and outlet ports—increased flow capacity, avoids backflow;
- ★ Drain connection added—available for bottom inlet;
- ★ One-piece, deep-drawn, stainless bucket—no welds;
- ★ Larger gasket area—positive seal;
- ★ Improved, stainless, high-ratio leverage.

With a complete line of Strong open and inverted bucket traps, our engineers can specify exactly the *right* type for your particular application. Write for our HI-CAP Bulletin for complete details on the new HI-CAP traps.

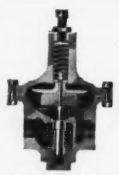
STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street • Cleveland 13, Ohio
**HI-CAP, Trade Mark Registered*

REG. TRADE MARK

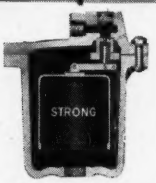
OTHER ANUM-METL Reg. Trade Mark

STRONG

STEAM SPECIALTIES


Reducing Valve

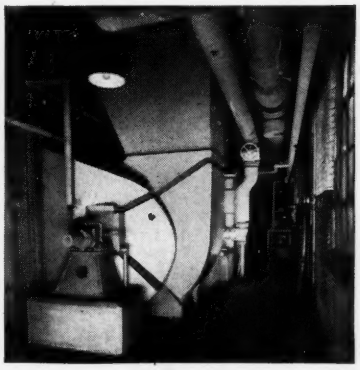
Strainer



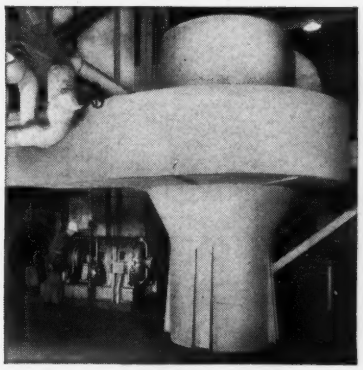
No. 80 Series Trap

Want to *work magic* on 3 at a time?

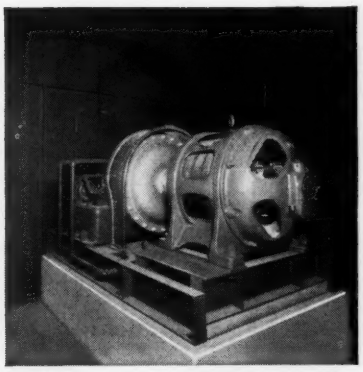
Mechanical Draft Fans, Fly Ash Precipitators, Variable Speed Control—You can pull these three out of one hat! No magic wand is needed, just specify American Blower. When you do, you save time and trouble. You centralize responsibility and gain one reliable source of supply and technical information.



1 Mechanical Draft Fans. Many public utilities bought their first mechanical draft fan from us. And with each addition to their facilities, American Blower mechanical draft fans were ordered again. Many utilities are also using our . . .



2 Precipitators for collecting fly ash and cinders. They like these precipitators because the design is simple (no moving parts), upkeep is low and space requirements are small. Still another American Blower product which has gained wide popularity is . . .



3 Gyrol Fluid Drive for variable speed control. The first industrial application in America was on a mechanical draft fan. Since then more and more plants have used Gyrol Fluid Drive on both mechanical draft fans and boiler feed pump drives.

Phone or write the nearest American Blower Branch Office for a presentation of our services to power plants. A qualified and experienced representative is ready to help you.

Buy all 3 from ABC

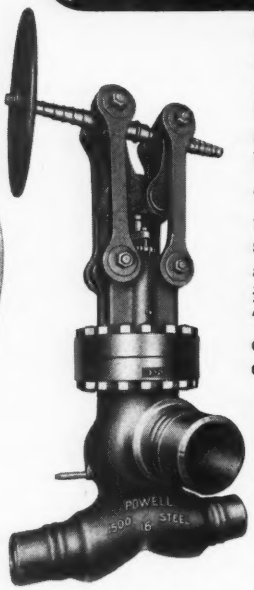
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

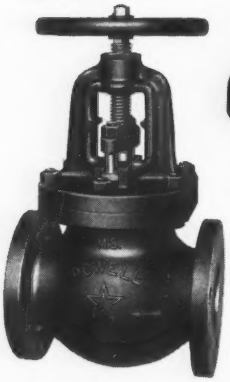
POWELL has the *right* Valves for *all* your Flow Control requirements!

Large 125-pound Iron Body Bronze Mounted O. S. & Y. Gate Valve.

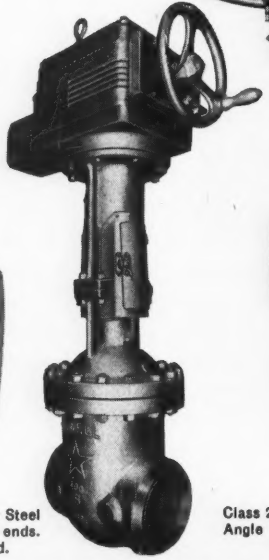


Class 1500-pound Cast Steel Non-return Angle Valve, with welding ends. Has a 16" outlet and two 12" inlets. Toggle operated.

200-pound Bronze Gate Valve with renewable, wear-resisting disc.



Large 125-pound Iron Body Bronze Mounted O. S. & Y. Globe Valve.



Class 300-pound Cast Alloy Steel Gate Valve with welding ends. Electric motor operated.

This may sound like a broad statement—but we can back it up. Because, through 100 years of making valves—and valves only—Powell has always been ready with valves that are *right*—in both design and material—to meet *all* demands imposed by the amazing growth of American Industry.

Today the Powell Line of Valves for Power Plants includes Bronze and Iron Valves of every necessary type, size, design and working pressure and a complete line of Cast Steel Valves of every type in pressure classes from 150 to 2500 pounds. This includes a number of special designs and an outstanding line of gear, toggle and motor operated Non-return Valves.

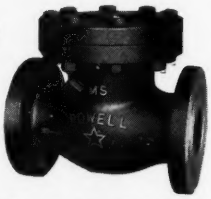
The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

Catalogs furnished on request. Kindly state whether you are chiefly interested in Bronze, Iron, or Cast Steel Valves.

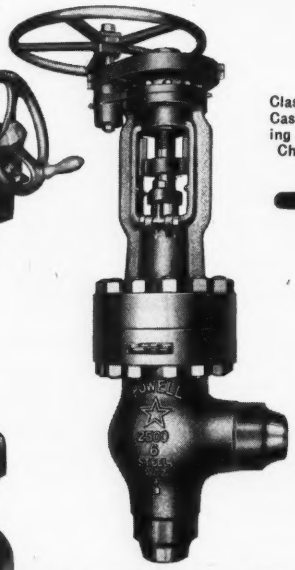
See our exhibit in BOOTH 49 at the 17th National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, December 2—7, inclusive.

200-pound Bronze Globe Valve. Renewable, wear-resisting, semi-cone plug type seat and disc.

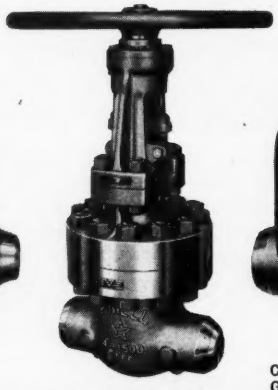


250-pound Iron Body Bronze Mounted Horizontal Swing Check Valve.

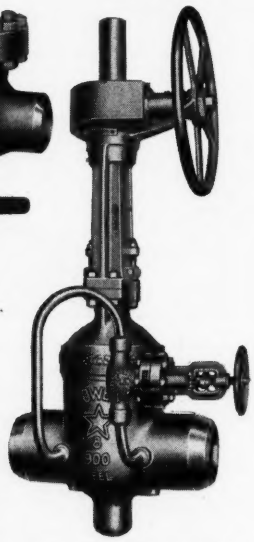
Class 300-pound Cast Steel Welding End Swing Check Valve.



Class 2500-pound Cast Alloy Steel, Angle Valve with welding ends. Spur gear operated.



Class 1500-pound Cast Steel Welding End O. S. & Y. Gate Valve.



Class 900-pound Cast Steel Gate Valve with welding ends, welded bonnet, and special by-pass. Bevel gear operated.

POWELL VALVES

IMPRESSIVE FIGURES!

SINCE PEARL HARBOR

(Advertisement printed December, 1941)

STILL MORE IMPRESSIVE TODAY!
4 VERY IMPRESSIVE FACTS
18,221,000 lb. per hr. Steam Generated
1,102,500 K.W. per hr. Capacity
900°F. to 950°F. Temperature Conditions
720 to 2200 lb. Pressure Range
KELLOGG

35,541,500 lb. per hr.
STEAM GENERATED
18,221,000 lb. per hr. in 1941

2,355,000 k.w. per hr.
CAPACITY* (High Pressure Units Only)
1,102,000 K.W. per hr. in 1941

900°F. to 1000°F.
TEMPERATURE CONDITIONS
900°F. to 950°F. Temperature Conditions in 1941

650 to 2200 lb.
PRESSURE RANGE
720 to 2200 lb. Pressure Range in 1941

These figures show the confidence placed by Consulting Engineers, Central Station and Industrial Power Plant Engineers, in Kellogg's ability to design, fabricate and erect piping installations, which perform as required, under the most advanced techniques of pressure and temperature.

While the figures show only high pressure installations, The Kellogg Company has also prefabricated and erected many piping jobs for lower pressures.

KELLOGG

"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.
REPRESENTATIVES
LOS ANGELES: 609 SOUTH GRAND HOUSTON 2, TEXAS: 402 ESPERSON BLDG TULSA: PHILTOWER BLDG.

In Step with Industry

Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.

Paracoil

HEAT TRANSFER EQUIPMENT

Davis Engineering Corporation has played a major part in the development, design betterment and manufacture of distillation, evaporation and heat exchange equipment for more than 30 years.

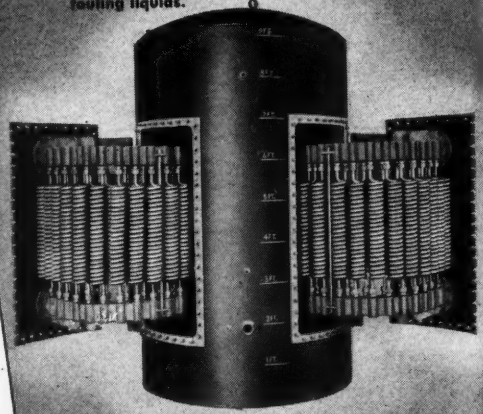
Pictured are Paracoil Heat Transfer units designed to serve America's industries as well in peace as they served the country during the war. Davis built heat exchangers assure greater production efficiency, reduced repair and cleaning costs and freedom from shutdown losses.

Paracoil equipment is available for practically every type of heat transfer application called for by our many and varied industries.

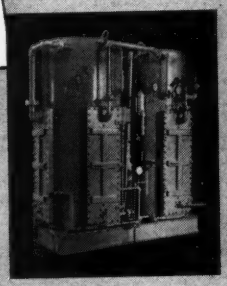
Technical and practical knowledge accumulated from 30 years of manufacturing experience and job performance, supplemented by continuous engineering research, have resulted in fundamental design improvements effecting advanced performance and increased resistance to severe service conditions.

Whether yours is a replacement, new, or more efficient equipment need, Paracoil Heat Exchangers are available on most reasonable delivery schedules and Davis engineers are ready to assist in making proper selection of size and design best suited for your particular problems.

To those with fouling problems: Write for bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.

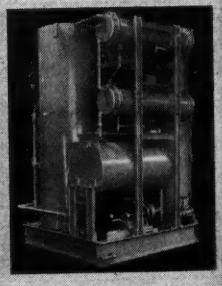


Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



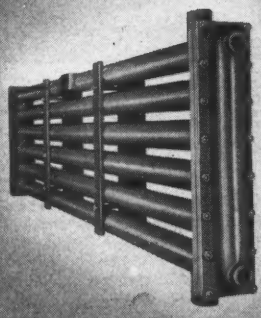
FRONT VIEW

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.



BACK VIEW

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of Inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for crossing temperature conditions. Straight tubes easily cleaned.

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

DAVIS ENGINEERING CORPORATION
1069 EAST GRAND STREET, ELIZABETH 4, NEW JERSEY

LADISH

Controlled Quality

..WHAT IT MEANS IN GREATER DEPENDABILITY AND LONGER SERVICE FROM PIPING SYSTEMS

Controlled Quality is the distinguishing feature of every product in the complete Ladish line. Seamless Welding Fittings, Forged Steel Fittings and Forged Steel Flanges . . . all are produced under exacting metallurgical control and rigid inspection of physical dimensions.

Ladish Controlled Quality . . . made effective by one of the most modern and completely equipped metallurgical engineering laboratories in the industry . . . provides complete determination of chemical composition and physical properties of steel together with constant application of proper forging procedures and heat treating.

Thus users of Ladish Fittings and Flanges obtain higher dynamic strength . . . greater toughness . . . and increased resistance to shocks, strains and stresses common in piping installations. Advantages resulting from Ladish Controlled Quality provide the ultimate economy of longer life and greater dependability.

A COMPLETE LINE PRODUCED UNDER ONE RESPONSIBILITY

Ladish catalogs, to assist in the design of piping installations and the proper selection of fittings and flanges, will be supplied upon request.

TO MARK PROGRESS

Controlled Quality

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

District Offices: NEW YORK • BUFFALO • PITTSBURGH • CLEVELAND • CHICAGO • ST. LOUIS • HOUSTON • NEW ORLEANS • LOS ANGELES

How to give a Bigger Bonus

...without budging your budget a bit!

SUPPOSE Bill S., one of your employees, is due for a $75 bonus this year. If you give the bonus in U. S. Savings Bonds, Bill will receive—not $75, nor a $75 Bond—but a *$100* Bond.

Yes, the bonus in Bonds looks like a lot more—and it *is* more. (Every $3 put into U. S. Savings Bonds pay $4 at maturity.) With the same size appropriation, you're actually giving a bigger bonus.

Consider, too, that Savings Bonds mean individual security for each Bond-holder—and collective security for all of us, because they help to control inflationary tendencies. You can easily see that you're doing yourself, your employees, and your country a favor by deciding to...

Give the BONUS in BONDS

...and keep up your Payroll Savings Plan!

IMPORTANT: If you have not already received your copy of "How You Can Help Give Free Enterprise a Boost," write on your letterhead to: Room 750, Washington Building, U. S. Savings Bonds Division, Washington 25, D. C. Limited supply. Please write today.

The Treasury Department acknowledges with appreciation the publication of this message by

POWER PLANT ENGINEERING

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

ENGINEERING PROGRESS REPORT # 5

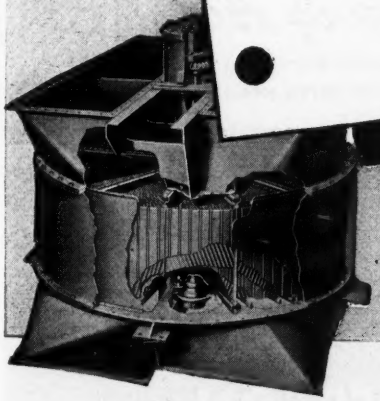
LJUNGSTROM AIR PREHEATER

Savings Begin With Installation

In selecting a preheater, after factors of all-over design have been properly weighed, it is well to consider these capital expenditures:

CAPITAL EXPENDITURES

1. FIELD. Because the Ljungstrom is fabricated at the factory as a unit, installation expenditures are lower.
2. There are building and structural savings possible because the Ljungstrom is smaller and more adaptable to a large variety of layouts.

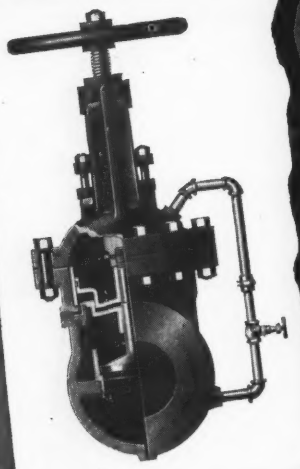


THE

AIR PREHEATER

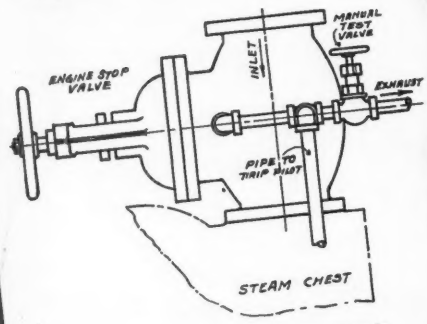
CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.



HOW TO AUTOMATICALLY PREVENT TURBINE OR ENGINE OVERSPEEDING

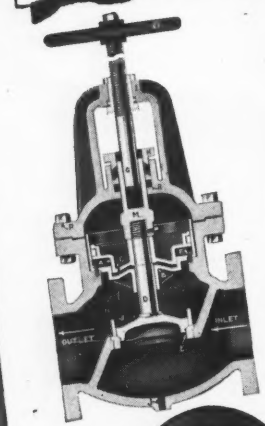
install GOLDEN-ANDERSON THROTTLE and AUTOMATIC ENGINE STOP VALVES



Golden-Anderson Throttle-Engine Stop Valve in horizontal position with downward steam flow.

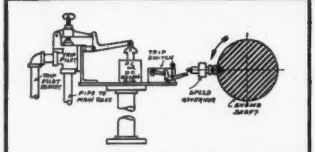
On overspeeding of engine or turbine the shaft governor may directly operate trip pilot control valve or limit switch, if solenoid trip pilot control is used, to open trip pilot control valve and permit engine stop valve to instantly close and stop engine or turbine.

By running down handwheel stem the valve may be closed any time, and by-pass valve should be closed when the valve is to be maintained in closed position over a period of time.

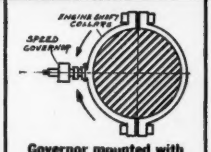


Free Engineering Aid...

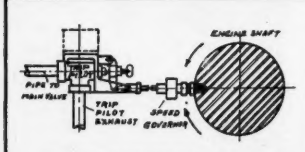
Let GOLDEN-ANDERSON engineers help you on any new or replacement valve problem.



Electric trip pilot and switch assembly with governor attached to engine shaft.



Governor mounted with split collars attached to engine shaft.

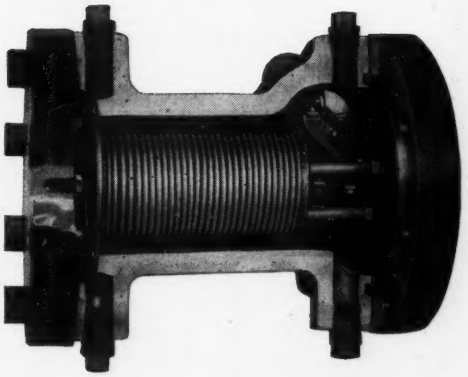


Mechanical trip pilot assembly with governor attached to engine shaft.

GA **GOLDEN-ANDERSON VALVE Specialty Company**
KEENAN BUILDING · PITTSBURGH 22, PA.

NOW TAYLOR FLOWMETER USES NO MERCURY, NO PIVOTS, NO STUFFING BOX!

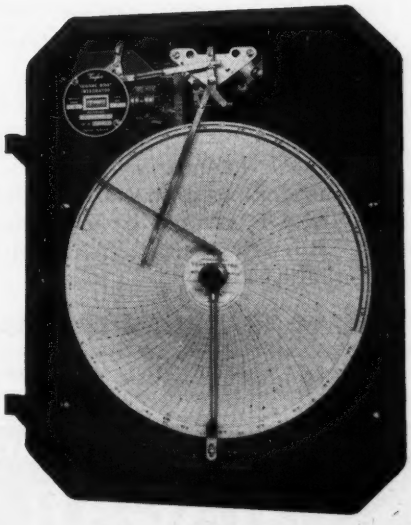
HERE'S the instrument you may have been waiting for! The Taylor Aneroid (mercuryless) Manometer for rate of flow. Thoroughly field-tested in wartime chemical and petroleum plants. Maintenance is cut to a minimum because there is no mercury to replace, no stuffing box, no internal pivots to wear out. Differential pressure is measured by a bellows and transmitted through a torque tube. Together with the new Taylor Integrator (see below) it will give you a complete measurement of the flow of liquids, gases, or steam.



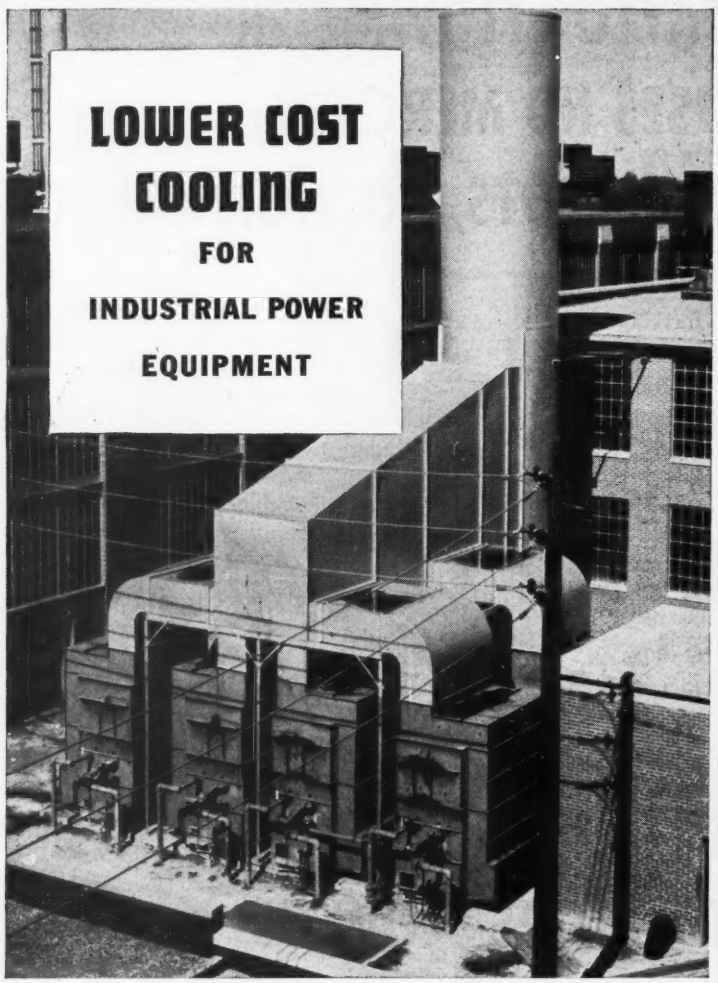
NEW TAYLOR INTEGRATOR TOTALIZES FLOW OF LIQUIDS, GASES OR STEAM!

A STURDY, compact new instrument for accurately totalizing the flow of liquids, and gases and steam under constant pressure. Built for years of accurate, steady service.

You can always depend on the totals—easily read through a large (2 inch) window in the case door. Auxiliary scale and pointer facilitate rapid checking of calibration. Write for new catalog on Taylor Flow and Liquid Level Instruments. Or ask your Taylor Field Engineer to call. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*



Taylor Instruments mean ACCURACY FIRST!



NIAGARA AERO HEAT EXCHANGERS provide a closed system of re-circulated clean jacket water at controlled temperatures and without the consumption of cooling water except for the small amount which is evaporated. Heat is absorbed at the rate of 1000 BTU per pound of water evaporated.

Ample cooling capacity is available in compact, economical equipment. There are additional savings in the cost of piping and pumping.

The operating dependability of NIAGARA AERO HEAT EXCHANGERS is assured by their record of long years of service under the most difficult industrial conditions. Ask for Bulletin 96-PP

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

405 LEXINGTON AVE., NEW YORK 17, N.Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING • HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

(*Continued from page 132*)

BCR'S REPORT NO. IX

BITUMINOUS COAL RESEARCH, INC., is distributing its Technical Report No. IX, "The Corrosion of Feed Screws of Small Underfeed Stokers." This booklet reports the results of an investigation made at Battelle Memorial Institute, Columbus, Ohio, under the joint sponsorship of BCR and the Calcium Chloride Association. Recommendations are given in the booklet for preventing or reducing corrosion at these points.

Ralph A. Sherman, John F. Foster and Don A. Hinckle of the Battelle fuels division staff are authors of this technical report that is based on extensive laboratory tests.

DR. DEAN ENTERS PRIVATE BUSINESS

AFTER 17 YEARS with the Bureau of Mines, in which he rose from Chief Engineer of the Metallurgical Division to Assistant Director, Dr. R. S. Dean leaves Government service to re-enter private business.

As head of the Metallurgical Division of the Bureau, Dr. Dean has been responsible for the initiation of the Bureau's work in pure metals, including electrolytic manganese, electrolytic chromium, ductile titanium, cobalt, zirconium, etc. He also personally directed a program of alley development based on these metals as well as work on magnetic separation and new flotation reagents.

Dr. Dean will continue professional work in Washington, already having commissions for research and development in electrometallurgy and alloys. These are fields in which he was active both while in Government service and while engaged in private industry.

WESTINGHOUSE ENGINEERS ASSIGNED TO OAK RIDGE

NINE ENGINEERS of the Westinghouse Electric Corp., including five from the staff of the Westinghouse Research Laboratories, will go to Oak Ridge, Tenn., to join the pool of scientific manpower which will work on peacetime applications of atomic power.

The engineers will carry on research at an Institute of Nuclear Studies which is being established as a "super-university of the atomic age" to provide channels for cooperative research between government, universities and the industrial concerns which have been involved in the atomic energy project at Oak Ridge.

On one year loan for this important work from the Westinghouse Research Laboratories are Dr. Elmer B. Ashcraft of the chemical and metallurgical department; Dr. Sidney Siegel of the magnetic department; Dr. R. C. Masen of the electrophysics department; Dr. Jerald E. Hill and Dr. L. P. Hunter of the electronics department.

The other Westinghouse engineers sent to Oak Ridge include two from the East Pittsburgh Works, J. W. Simpson of the switchgear engineering department, and A. H. Toopfer of the district engineering and service department; and two from the South Philadelphia, Pa., Works, N. J. Paladino and E. F. Miller of the Steam Turbine Division.

Sponsored by a group of southeastern universities, the Institute of Nuclear Studies will carry out research at the Ph.D. level and above in the fields of physics, chemistry, biology, medicine, and engineering.

"Absence of Sludge with Tycol turbine oil"

"Fifteen years without oil change . . .
Oiling system clean at all times . . .
Low maintenance costs . . .
Tycol turbine oils used exclusively..."

— that's how one general superintendent describes the superior qualities of Tycol Turbine Oils. "These qualities are extremely important to us," he added, "and have, of course, resulted in low maintenance costs."

For full details concerning Tycol Turbine Oils, call, write, or wire your nearest Tide Water Associated Office.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N. Y.

MURRAY

TYPE S

SINGLE STAGE TURBINES FOR MECHANICAL DRIVE

Murray Type S single stage turbines for mechanical drive have horizontally split casing with steam and exhaust connections in lower half. Two-row impulse type stainless steel blading. Completely enclosed constant speed governor and emergency overspeed governor. Carbon ring glands. The unit is compact with the ruggedness expected on this type drive. Suitable for driving centrifugal pumps, fans, blowers, and small generators.

Write today for Murray Bulletin 121—it illustrates and describes in detail Murray Type S Turbines.

Murray also produces:

Turbine Generators up to 3,000 KW rating. High speed reduction gears.
Vertical Steam Turbines, both direct connected and geared. Steam Boilers.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

The appointment of N. O. Wood, Jr., as assistant deputy administrator, has just been announced. Mr. Wood who has been chief of the field office division, SFA, succeeds E. Boykin Hartley who has been named associate director of the Surplus Property Office of the Department of the Interior's Division of Territories and Island Possessions.

Obituaries

DR. A. R. STEVENSON, JR.

DR. A. R. STEVENSON, JR., staff assistant to General Electric's Vice President in Charge of Engineering Policy, died recently in Schenectady following a heart attack. Dr. Stevenson had been assigned to matters of education and the training of personnel and was secretary of the company's Engineering Council.

A graduate of Princeton University and Union College, Dr. Stevenson joined General Electric in 1918. During World War I he served as chief of the Radio and Electrical Section of the Air Service in Paris and in subsequent years as president of the American Society of Refrigeration Engineers.

EDWIN A. LEWIS

EDWIN A. LEWIS, former vice president and general manager of the Atlantic City Electric Co., who had served in the same capacity with the Ohio Power Co. for the last several years, died recently in Canton, Ohio. He was 62 years of age.

Surviving Mr. Lewis are his wife, Maude, and two daughters, Emily, and Mrs. Burton J. Hutchings of New York City.

HORACE E. SIBSON

HORACE E. SIBSON, member of the board of directors of Cochrane Corp., died September 18, 1946, at Germantown, Pa. Until a year ago Mr. Sibson was vice president and sales manager of the Company from which position he retired because of ill health. Mr. Sibson was well known by users and manufacturers of steam and water conditioning equipment throughout the country. He was also a director and vice president of the Tacony-Palmyra Bridge Co., Philadelphia.

THOMAS MORRISON

THOMAS MORRISON, a director of The International Nickel Co. of Canada, and a former director of United States Steel Corp., died at his home in Spring Lake, N.J., recently.

Mr. Morrison was born in Scotland on December 5, 1861. He served an apprenticeship as a machinist and engineer in Scotland and came to the United States in 1886. After joining the Carnegie Steel Corp., he was made superintendent of the Duquesne Works of that organization in 1891 and general superintendent of its Edgar Thomson Works in 1895, from which he resigned in 1901. Together with Julian Kennedy, Mr. Morrison was coinventor of a process of slow cooling for rails, known as the Kennedy-Morrison process.

Mr. Morrison has been a director of International Nickel Co. since May, 1917. He was the second oldest Board member in point of service.

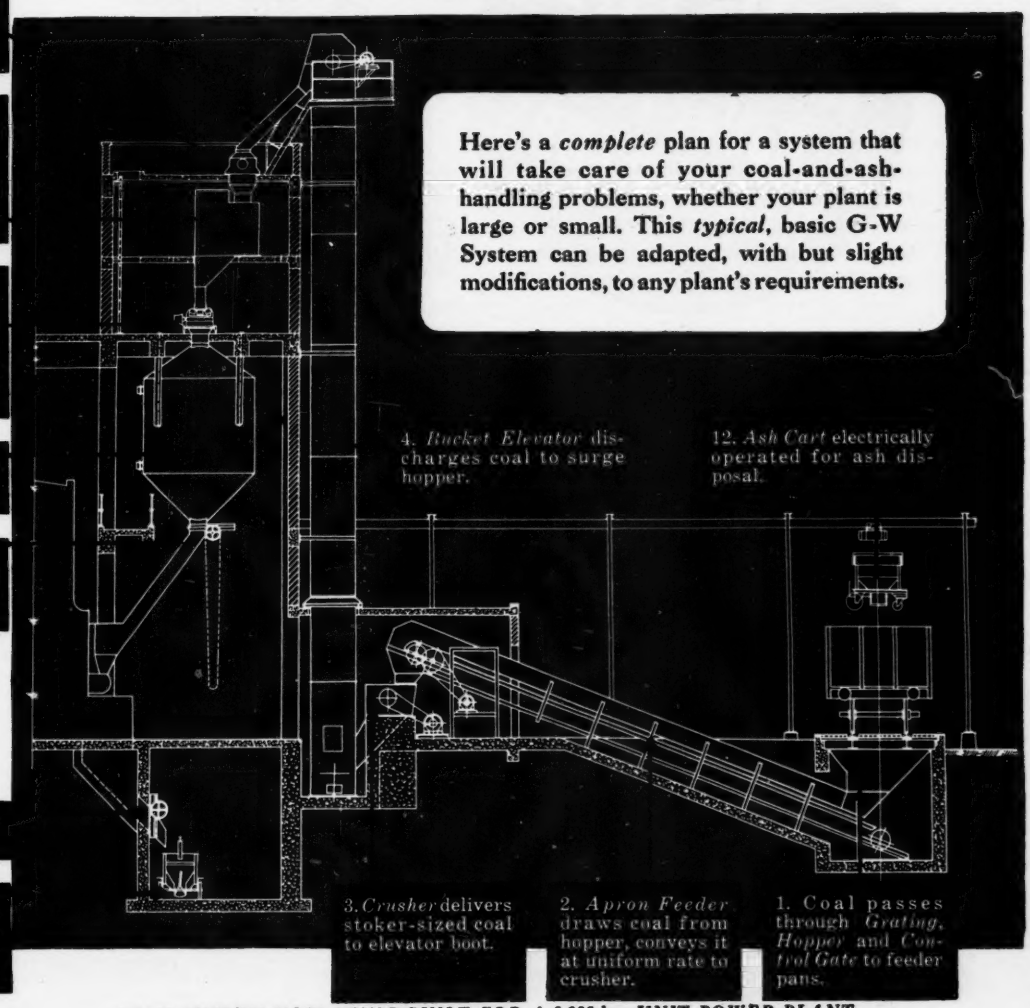
FRANK J. HEARTY

FRANK J. HEARTY, former President of F. J. Hearty & Co., Los Angeles and San Francisco, and veteran west coast representative of Edward Valves, Inc., died Nov. 3 after a short illness.

Mr. Hearty headed the firm which represented Edward in the west for more than 25 years. He served as an engineering officer in the U. S. Navy in both the Spanish-American and first World War, and spent 12 years in power plant design and construction before becoming associated with Edward Valves.

He has been succeeded as head of F. J. Hearty & Co. by Paul E. Bradfield who has been manager of the Los Angeles office for some time.

This *one* basic blueprint* solves *all* problems in coal-and-ash-handling


5. *Surge Hopper Control Unit* assures constant supply to scale.
6. *Scale* automatically weighs, records and discharges to shuttle belt conveyor.
7. *Shuttle Belt Conveyor* serves several bins from central weighing point.
8. *Storage Bins* have coal level control.
9. *Control Gate* and *Spout* to stoker.
10. *Ash Unloading Gate.*
11. *Ash Cart* manually operated through tunnel.
Here's a *complete* plan for a system that will take care of your coal-and-ash-handling problems, whether your plant is large or small. This *typical*, basic G-W System can be adapted, with but slight modifications, to any plant's requirements.
4. *Bucket Elevator* discharges coal to surge hopper.
12. *Ash Cart* electrically operated for ash disposal.
3. *Crusher* delivers stoker-sized coal to elevator boot.
2. *Apron Feeder* draws coal from hopper, conveys it at uniform rate to crusher.
1. Coal passes through *Grating, Hopper* and *Control Gate* to feeder pans.

*G-W SYSTEM NOW BEING BUILT FOR A 2,000 kw. UNIT POWER PLANT.

COAL IN... ASHES OUT

HANDLING HEADQUARTERS
for Industrial Conveying and Elevating Equipment . . . for Infra-Red Baking and Drying Equipment . . . for Ice Handling Tools and Ice Processing Machines.

G-W HANDLES IT...
faster • easier • cheaper

G-W will do the complete job. From start to finish G-W shoulders full responsibility for all details of design, manufacture, and erection. You save the time and money usually spent in dealing with sub-contractors. Two-way assurance that G-W will install the coal-and-ash-handling equipment that's best for your plant: hundreds of satisfied G-W equipment users; more than 130 years' experience in designing material-handling equipment for all types of industries. Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill.—Factory: Hudson, N. Y.

1469

GIFFORD-WOOD
SINCE 1814

HENSZEY
Boiler Feed
REGULATORS

Require LESS SPACE!

These simple, compact, self-contained units are easy to install. They go directly in the line and need no structural supports. Once in operation, no further attention is necessary. Works on the metallic expansion principle — no small tubes to spring leaks — nothing to rust — nothing to get out of order. Special valves made expressly for these instruments by a prominent valve maker assure positive trouble-free operation.

When the boiler needs water, the Henszey Regulator automatically springs into action — delivers just the right amount of water to bring the level back where it belongs. Provides positive boiler water level control continuously and accurately under all load conditions.

Made for pressures up to 600 lbs. and in sizes up to 4 inches.

Send for complete details.

HENSZEY COMPANY
DEPT C12, WATERTOWN, WIS

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

MANUFACTURERS' *News*

HAGAN-HALL TRANSFERS PERSONNEL

H. A. REDA and D. B. Jones were recently transferred from the Pittsburgh office of Hall Laboratories to the Hagan-Hall engineering and chemical engineering service staff at Detroit. They will handle service for industries in the southern Michigan and northwestern Ohio territories.

Before joining the staff of Hall Laboratories, Mr. Reda was a metallurgist with the Carnegie-Illinois Steel Co. Mr. Jones joined the service staff of Hall Laboratories in 1939 and recently returned to the company after 25 months with the Navy in charge of radar aboard a destroyer in the Pacific.

W. H. Weitzel, who has been service engineer for Hall Laboratories out of Detroit, will transfer to sales work.

NEW G. E. SERVICE FACILITIES

A NEW COMBINED service shop and warehouse in Baltimore, and a new service shop and warehouse in Denver have been added to General Electric's network of apparatus repair and replacement facilities, according to Company officials. This brings to 25 and 28, respectively, the number of G-E service shops and warehouses located in principal cities throughout the country.

GARDNER-DENVER APPOINTS GENERAL SALES MANAGER

G. V. LEECE, Vice-President of Gardner-Denver Co., has been appointed General Sales Manager for the company, effective immediately. Mr. Leece joined the Gardner-Denver Co. in 1922 and is now rounding out approximately twenty-four years of service. For the past two years his position has been that of Vice President in charge of the Export Division with offices in New York City. For five years previous to this appointment, he was District Manager of the New York branch office and for seven years prior to this period he had been Pacific Coast Manager.

ARTHUR D. LITTLE, INC.'s SIXTIETH ANNIVERSARY

THE INCREASING maturity of research as a function of industry is indicated in the recent announcement of the sixtieth anniversary of Arthur D. Little, Inc., probably the oldest of the existing consulting industrial research laboratories and the largest of those which are not endowed institutions. The laboratories were founded as the firm of Griffin and Little in a small office in downtown Boston in 1886. The present staff of 175 now occupies a group of buildings in Cambridge, Mass., and with the general growth of interest in industrial research, has been extended to cover practically all fields of applied science, including applied biology, chemistry, chemical engineering, mechanical development, and technical economic evaluation of new ventures.

DOLLINGER HOLDS SALES MEETING

THIRTY SALES representatives of the Dollinger Corp. from every section of the United States got a preview of new designs of Staynew Filters at a three-day sales conference September 20, 21 and 22 . The conference was held at the company's Rochester plant and at Longue Vue, Thousand Islands.

Inspection of the plant and study of manufacturing processes were followed by examinations of new models of Staynew Filters for air, other gases and liquids. These included special high pressure and high temperature pipe line models and large-capacity automatic filters for ventilating systems.

WHERE WIRING MUST STAND UP TO...

OILS *Cutting oils, lube oils, and coolants won't damage it.*

ACID *Neither battery acids, nor other mild acids and alkalies harm Flamenol.*

WATER *Flamenol will take months of continuous immersion, and come out as good as new.*

FIRE *Flamenol can't help a fire along, as it will not support combustion.*

HEAT *Flamenol is unaffected by any heat to which wiring is normally subjected (as high as 80 C).*

WEATHER *Ordinary low temperatures or sunshine won't hurt Flamenol.*

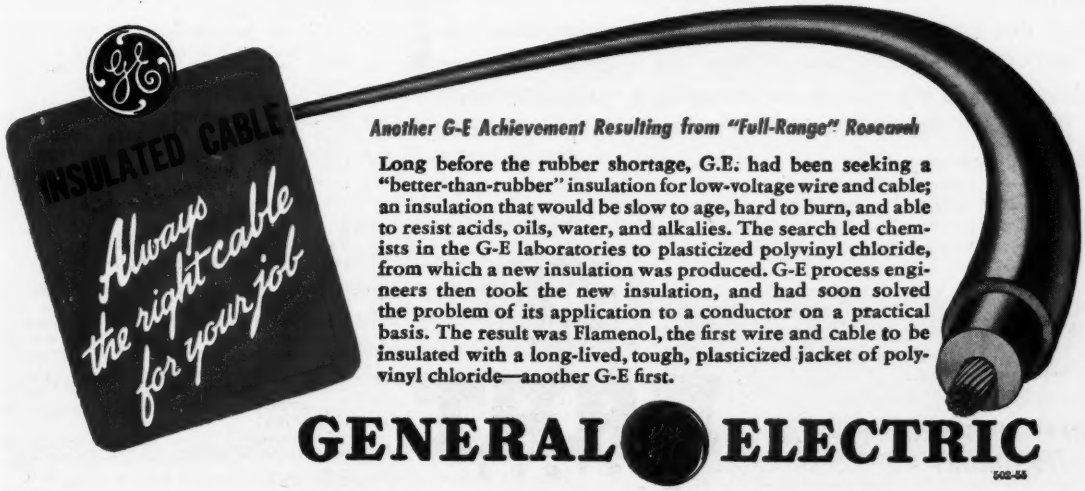
Specify FLAMENOL cable

Industrial operations and conditions that menace most wiring seldom harm the tough, flexible polyvinyl-chloride insulation of Flamenol* cable. That's why over 250,000,000 feet of Flamenol wire and cable have been installed in rough-on-wiring locations. You'll find it holding up on rayon-spinning machines, battery-charging equipment, printing-press controls. It's working overtime in canneries and tanneries. Chances are where you find wiring exposed to oil, grease, gasoline, printing inks, corona, weather and abrasion, you'll find Flamenol on the job.

Suitable for applications up to 600 volts, Flamenol's small diameter saves space in crowded quarters, while its smooth, tough, glossy surface eases pulling through conduits. Although it is free-stripping for easy connections, it's tensile strength of 1,500 lb per square inch means it can stand a lot of abuse.

There's a Flamenol cable for almost every wiring application. Write for Bulletin GEA-4352. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

**Trademark Reg. U.S. Pat. Off.*



Another G-E Achievement Resulting from "Full-Range" Research

Long before the rubber shortage, G.E. had been seeking a "better-than-rubber" insulation for low-voltage wire and cable; an insulation that would be slow to age, hard to burn, and able to resist acids, oils, water, and alkalies. The search led chemists in the G-E laboratories to plasticized polyvinyl chloride, from which a new insulation was produced. G-E process engineers then took the new insulation, and had soon solved the problem of its application to a conductor on a practical basis. The result was Flamenol, the first wire and cable to be insulated with a long-lived, tough, plasticized jacket of polyvinyl chloride—another G-E first.

GENERAL ELECTRIC

502-55

Darts Don't Drip

BECAUSE THEIR TWO BRONZE SEATS ARE SPECIALLY GROUND TO MEET IN A TRUE BALL JOINT

Darts close to a drop-tight connection—close smoothly and easily, because both bronze seats are carefully ground to form a true ball joint. If needed in other locations they may be uncoupled instantly and without the slightest damage. Bodies and nuts are of high-test air-refined malleable iron—are practically indestructible. That's why Darts are cheapest in the long run.

Ask your supplier to demonstrate the unique Dart construction.

E. M. DART MANUFACTURING CO.
PROVIDENCE, R. I.

DART UNIONS

BLAW-KNOX GETS L. A. CONTRACT

In an expansion of its power plant facilities, the City of Los Angeles has awarded Power Piping Division of Blaw-Knox Co. a piping contract of approximately $400,000. This will cover the supply and installation of all piping, including high-pressure alloy steel piping, to be used in a new steam turbine electrical power unit.

Boiler capacity will be 675,000 lb per hr, the turbine will be rated at 65,000 kw, and the operating pressure will be 1050 psi at a temperature of 915 F. Installation is to begin early in 1947.

KOPPERS BUILDING PRECIPITATORS

Precipitators which will remove either solid or liquid particles from plant discharge gases are made available to American industry by Koppers Co., Inc., it was announced recently.

Called the Koppers-Elex Electrostatic Precipitator, the equipment will be engineered and built at Koppers' Bartlett-Hayward Plant in Baltimore.

Koppers has accepted a number of orders for these precipitators and has been engaged in the engineering work on them for several months. The Bartlett-Hayward Plant is ready to go into production on the first orders for the Swiss-invented apparatus, and it has acquired exclusive manufacturing and sales license rights in North America.

The precipitators are designed for maximum removal or recovery of solid or liquid particles from industrial and waste gases, and are engineered specifically to the needs of individual plants to provide any desired efficiency.

GEORGE TORRENCE LINK-BELT PRESIDENT

George P. Torrence, executive vice-president of Link-Belt Co. since July 1, became president of the company, effective Nov. 1, succeeding William C. Carter.

Mr. Torrence, a graduate of Purdue University in mechanical engineering, class of 1908, in addition to his experience with Link-Belt Co., was general manager of Rayon Machinery Corp., a subsidiary of Industrial Rayon Corp, from 1936 to 1944; and president of Cleveland Pneumatic Tool Co. from 1944 to 1946.

His experience with Link-Belt dates back to 1911, when he entered the company's employ in Indianapolis as draftsman, after having spent a year in Arkansas with the Ayer & Lord Tie Co. as assistant oiler in the power plant, and two years as shop apprentice in the Pittsburgh shops of Westinghouse Air Brake Co.

In his 25 years with Link-Belt, Mr. Torrence served in various capacities beginning as draftsman. He was manager of the Indianapolis operations from 1926 to 1932 and president from 1932 to 1936.

CLIPPER PLANT EXPANSION

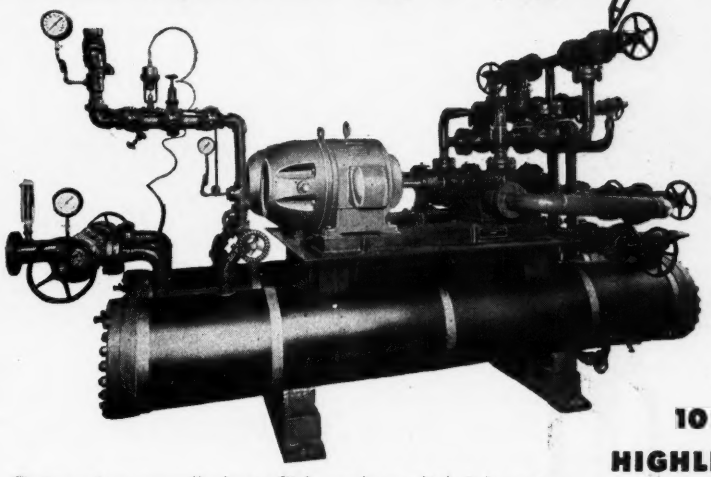
Clipper Manufacturing Co., formerly of St. Louis, has announced that its St. Louis office will be consolidated with the newly completed factory and general office building in Kansas City, Mo. The St. Louis warehouse will remain intact. The announcement also pointed out that manufacturing facilities have been expanded and a complete laboratory has been added in which to test cutting results on every masonry material. The address of the new location is 2800 Warwick, Kansas City 8, Mo.

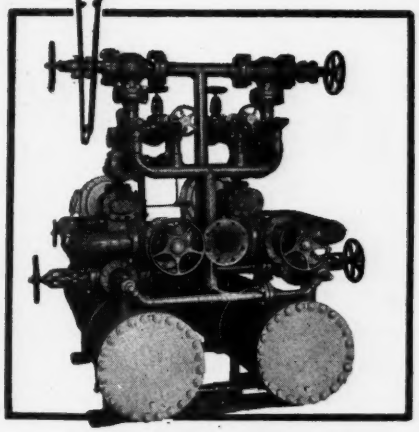
BEAUMONT BIRCH BUYS HAGAN CONVEYORS

Beaumont Birch Co. of Philadelphia announces that it recently purchased the complete line of Hagan steam jet ash conveyors from the George J. Hagan Co. and will furnish replacement parts. In addition, important features of the Beaumont Vac-Veyor and semi Vac-Veyor systems will be available to further improve the efficiency and economy of the Hagan line.

The George J. Hagan Co. will continue the manufacture of other lines of industrial equipment.

ENCO designed pump sets eliminate fuel-oil preparation troubles in the planning stage





Today when overall plant efficiency is so vital, it is more necessary than ever for you to be sure that your fuel oil pumping and heating system is designed to provide peak performance *to meet your special plant conditions.*

Many years of experience in planning these installations enables ENCO engineers to design the unit that suits your operating conditions best . . . "tailor made" so that every part is integrated to provide you with easier control and longer maintenance-free operation.

ENCO pumping and heating sets are both simple and economical to install, too. They are delivered in a coordinated unit, ready to connect to station piping and run. And every ENCO Fuel Oil Pumping and Heating Unit is completely tested under high pressures before it is shipped to you.

ENCO "tailor made" pump sets are available in full or semi-automatic models with single or duplicate combinations of steam piston, turbine or electric driven rotary, or screw-type pumps. Pumps may be interconnected with one or two straight-tube heaters. Pumping sets with all-welded pipe connections are also available on request.

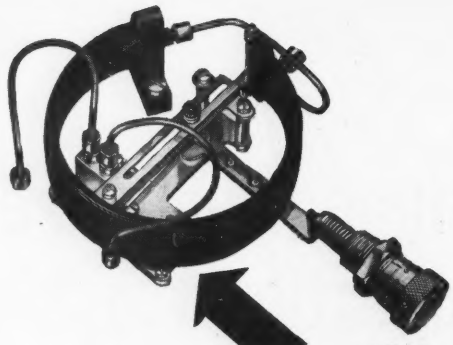
For further information on ENCO Automatic Fuel Oil Pumping and Heating Sets, write for Bulletin O.B.—37.

10 PLUS FEATURES THAT HIGHLIGHT ENCO'S SUPERIORITY

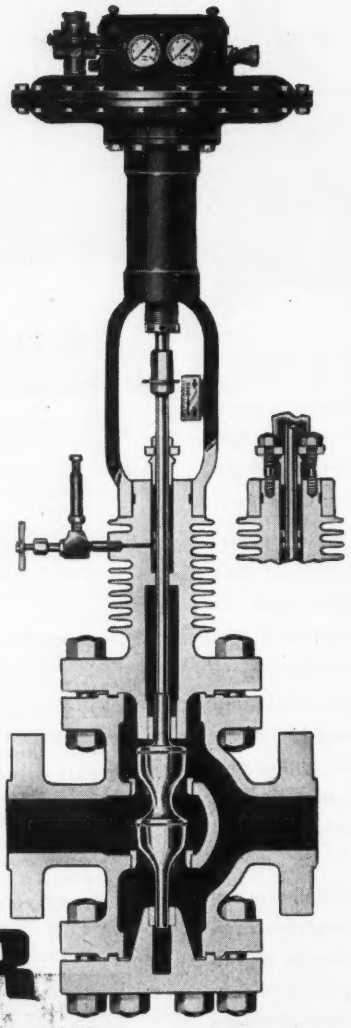
1. COMPLETELY AUTOMATIC OPERATION is assured by automatic temperature and pressure regulation valves.
2. COORDINATED DESIGN SAVES SPACE. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.
3. INDIVIDUALLY DESIGNED to meet the specific needs of the particular power plant in accordance with its exact operating requirements.
4. ALL PARTS VISIBLE AND ACCESSIBLE for easy operation, maintenance and repair.
5. PUMPS AND HEATERS are interconnected to provide maximum flexibility of operation.
6. SAFETY VALVES protect individual parts where required.
7. EASIER MAINTENANCE — LESS SERVICE-TIME FOR CLEANING because straight tube, multi-pass heaters with removable heads are used.
8. PUMPS OPERATE AT MODERATE SPEED. Heaters designed to give the correct viscosity and velocity without fouling.
9. SMOOTHER FLOW OF CLEAN FUEL TO FURNACE. Air chamber for each piston pump prevents pulsations — pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.
10. CLEANER BOILER ROOM . . . all overflows connected to a common outlet; flanged drip pan catches oil drip.

EC-466

THE ENGINEER COMPANY
75 West Street
New York 6, N. Y.
Canadian Representatives: P. J. Rankin, Ltd.
370 Rachel E., Montreal, P. Q.



THE "BRAINS" OF WIZARD CONTROLLERS



● This is the almost human mechanism of Fisher Wizard Controllers that provides accuracy in pressure control—dependability unlimited—and simplicity of design.

Every demand for accurate regulation on all pressure control applications is perfectly met by Fisher Wizards—they are individually built to your exact operating conditions and are guaranteed to give satisfactory performance.

Available in full throttling and snap acting types. Bourdon tube pressures up to 10,000 P. S. I. Diaphragm or remote panel mounting.

Write today for Fisher Wizard Bulletin "D".

FISHER GOVERNOR COMPANY
• 1035 FISHER BUILDING •
MARSHALLTOWN, IOWA

SCHAFER IDEAL'S NEW SALES MANAGER

WARD R. SCHAFER has been named general sales manager of Ideal Industries, Inc., Sycamore, Ill., it was announced recently. Mr. Schafer left his post of vice president in charge of sales of Edison General Electric Appliance Co. in Chicago for the new position on Nov. 1.

In announcing Mr. Schafer's appointment the company said that Ideal, which operates on a jobber basis, distributing its products through leading wholesalers in all parts of the United States, has embarked on an important expansion program. The program includes new buildings, additional machinery, and an expanded marketing program to take care of increased production facilities. Payrolls, number of employees and volume of business are at the highest point in the company's 30-year history.

The Pennsylvania Flexible Metallic Tubing Co., Philadelphia, is now publishing a house organ called "Penflex News." Editor of the paper is Anne S. Hoover, former member of the staff of the Philadelphia Record. Publication is part of new employee-management relation program instituted by Eugene J. Ronan, executive vice president.

MANUFACTURERS' *Personals*

Liquid Conditioning Corp., New York, announces a further extension of its engineering, sales and service field force. Ira J. Bready has been appointed District Manager in the Cincinnati territory. B. F. Soffe has been appointed District Manager in the Lower Michigan district, with headquarters in Detroit. H. H. Morrison has been appinted District Manager in the central and lower South, with headquarters in Chattanooga.

The Brown Instrument Co. of Philadelphia announces that a group of 45 new sales and service engineers will be assigned to various regional offices and branches throughout the country about the first of the year. All of these men are now attending the Brown Company School of Instrumentation at Philadelphia.

The Elliott Co. announces the appointment of Quentin Graham as manager of the Ridgeway (Pa.) Division, succeeding H. S. Pahren who has been appointed manager of the Company's New York City district. Mr. Graham was formerly manager of the Company's electrical engineering department where he concentrated on the design and production of several new lines of motors and generators.

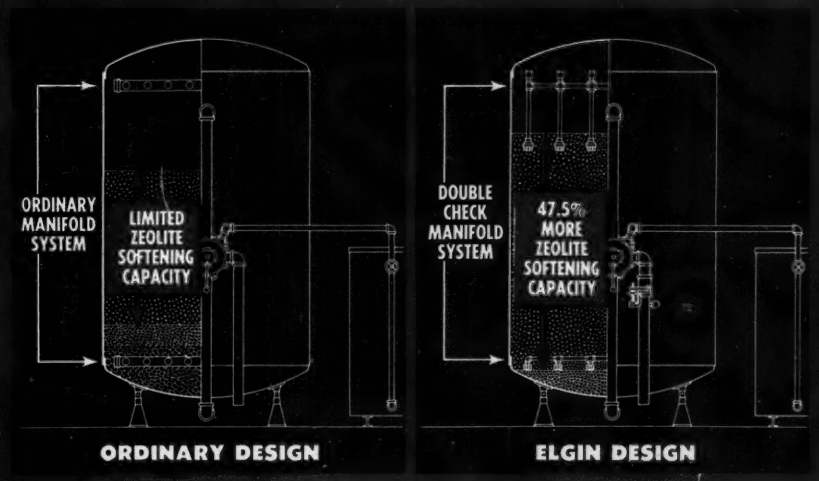
John C. Tracey, former Lt. Colonel of the U. S. Army Engineers, has been named Sales Engineer of the Washington, D.C. office of the Permutit Co., according to an announcement made recently by H. W. Foulds, president of the water conditioning firm. Mr. Tracey, whose experiences include eighteen months of road and airfield construction and maintenance on the Ledo Road in the China-Burma-India theater, left the St. Louis office of The Permutit Co. in 1941 to join the army.

Appointment of Arthur P. Shanklin as Vice President and General Sales Manager of Carrier Corp., has just been announced by Edward T. Murphy, Senior Vice President. Effective November 1, 1946, Mr. Shanklin will be in charge of all of Carrier's domestic sales activities.

Electric Machinery Manufacturing Co., Minneapolis, Minn., has elected Thomas Cruthers a member of the Board. Mr. Cruthers is a Vice-President of Worthington Pump, the parent company, at Harrison, N.J.

ELGIN WATER SOFTENER

gives 12,600 gallons more soft water



HERE is a typical example of Elgin performance. The two water softeners diagrammed above are identical in size (36" x 72"). Each uses synthetic zeolite to soften ten-grain water. In actual performance, the Ordinary Design softens only 26,500 gallons of water per regeneration, while the Elgin Design softens 39,100 gallons of water per regeneration. Think of it—12,600 gallons or 47.5% more soft water with the Elgin!

The reason for this remarkable increase in soft water output is shown in the illustrations above. Note the far greater zeolite content of the Elgin — made possible by an ingenious "Double-Check" manifold system. This design makes the deeper bed possible without loss of zeolite—a loss that the ordinary water softener attempts to avoid during backwashing by using a shallow zeolite bed, as illustrated.

Of course, more zeolite means more soft water output, for it's the zeolite that softens water. But the "Double-Check" manifold system goes beyond that . . . prevents zeolite loss . . . permits zeolite to be washed cleaner . . . prevents packing and channeling of the bed. Thus the brine reaches every granule of zeolite, producing more efficient regeneration with less salt consumption.

INCREASE THE SOFT WATER OUTPUT OF YOUR PRESENT WATER SOFTENER WITH "DOUBLE-CHECK" MANIFOLD SYSTEM

The "Double-Check" manifold system can be quickly installed in water softeners of any make. This change supplemented by remarkable high capacity ELGIN ZEOLITE *when required will greatly increase soft water output and operating efficiency. The cost of such modernization is surprisingly low.*

For facts about the Elgin Water Softener or modernization of your present water softener, write for Bulletin 607.

ELGIN SOFTENER CORPORATION, 136 N. Grove Ave., Elgin, Ill.

ELGIN
ECONOMICAL
WATER CONDITIONING

WATER CONDITIONING FOR EVERY NEED

Elgin is known for achieving results at lowest possible cost. The complete Elgin line includes: Boiler Water Treating and Purifying Systems • Feedwater Treatment • Deconcentrators • Water Softeners • Filters and Purifiers • Iron Removal Equipment • Aerators • Water Treating Chemicals • Chemical Feeders • Scale and Corrosion Inhibitors • Sample Coolers • Water Testing Equipment • Zeolite

ON the hot spots of industry—boilers, ovens, furnaces—ordinary insulation is likely to run a fever. That's why B-H Engineers developed MONO-BLOCK, the one-block insulation that keeps btu's where you want them.

Mono-block has a built-in heat barrier—effective up to 1700° F.—thanks to a felted construction that holds millions of extra insulating air-cells. And, it stands up under severe service conditions because the fibres are pure *black* Rockwool.

Wherever you have a hot assignment, Mono-block will stretch your insulation dollar for two more reasons:—1. *It's economical to use*, one block does the whole job. 2. *It's easy to install*, cuts easily and fits snugly over rivet heads and other irregular surfaces.

Take hold of a piece of Mono-block and see for yourself why it does such an efficient job of insulation. The coupon below brings descriptive literature.

Baldwin-Hill

Specialists in Thermal Insulation Products

Baldwin-Hill Co., 515 Breunig Ave., Trenton 2, N.J.

Send a sample of MONO-BLOCK and the B-H data book "Industrial Insulation" telling how it is used.

NAME..... POSITION.....

FIRM.....

ADDRESS.....

CITY..... ZONE..... STATE.....

Harry A. Reed has been elected Vice President of Day & Zimmerman, Inc. and will coordinate new business activities. Thomas W. Hopper will succeed Mr. Reed as Engineering Manager and will have charge of design and engineering for the construction department.

Ned Landis, formerly a lieutenant commander in the U. S. Navy, has been named branch manager of the Syracuse, N.Y. office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., according to a recent announcement.

John M. Lambert has been appointed the manager of consumer sales of York Corp., according to a recent announcement. Mr. Lambert will supervise all air conditioning and refrigeration sales made direct with users by the Corporation's district office organization in the United States. He will be supported by Fred C. Wood, manager of air conditioning sales and James Scott, manager of refrigeration sales.

Appointment of Harrison Wood as New York district manager for SKF Industries., Inc., was announced recently by the company. Mr. Wood, assistant district manager since 1941 and for many years a field engineer for the firm, succeeds John D. Williamson, who resigned because of ill health after serving as head of the district for 23 years.

Gardner-Denver Co. announces the promotion of B. P. Spann, formerly Advertising Manager of the company, to Personnel and Industrial Relations Director. Mr. Spann, who has been with the Gardner-Denver Co. since 1934, with the exception of 38 months in the Navy, where he attained the rank of Lieutenant Commander, will be in charge of all factory and office personnel for the Gardner-Denver Co. Quincy plant.

Perfex Corp., Milwaukee, announces the election of Carroll E. Lewis as Executive Vice President responsible for all general operations of the Company.

Appointment of John A. Buckley, formerly of the General Electric Co's. Lamp Department of Nela Park, Cleveland, as merchandise sales manager for the G-E Chemical Department was announced recently. Mr. Buckley who will be responsible for the sale of consumer goods items, will make his headquarters at Pittsfield.

J. Harper Claycomb has been elected treasurer of Cochrane Corp., according to a recent announcement from that company.

General Electric Co. announces the appointment of Lawrence L. Jones as superintendent of its new factory for the manufacture of Glyptal alkyd resins at Anaheim, Calif.

American Engineering Co., Philadelphia, recently appointed Stewart Walling of the Walling Co., 203 South Second Ave., East Newton, Iowa, as its sales representative on Taylor and AE Perfect Spread Stokers in the Eastern Iowa and Tri-City areas. This new branch office will give complete service to industrial and municipal power plants on both underfeed and spreader stokers.

Homer A. Goddard, lubrication engineer, has been appointed assistant division manager in charge of industrial lubricating sales for the Pittsburgh Division of Gulf Oil Corp., embracing Western Pennsylvania and West Virginia.

Charles F. Codrington has been promoted from assistant to the manager to sales manager of the blower and compressor department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., succeeding A. E. Caudle, resigned, according to a recent announcement.

Norman W. Stirling has joined the New York office organization of Elliott Co. As president of the Heat Exchange Institute for a one-year term and as president for three years of the Tubular Exchanger Manufacturers Association, of which he was also one of the organizers, Mr. Stirling has been exceptionally active in promoting the mechanical and thermal standardization of tubular heat exchangers for the petroleum industry.

Here's the Inexpensive Tool for cutting your gaskets quickly and easily!

Complete for only $19.50

You need the ALLPAX GASKET CUTTER Now!

OUTSTANDING IN HIGH EFFICIENCY.

This remarkable tool replaces slow, laborious methods of cutting gaskets with a simple, foolproof mechanical method of cutting which can be operated by anyone in the plant. It will pay for itself in the first few gaskets cut and effect savings every time it is used. The sooner you use it the quicker you'll save.

CUTS CLEAN GASKETS FROM 1" TO 36" IN A JIFFY . . . FROM ANY MATERIAL.

Whatever the gasket material . . . compressed asbestos sheet . . . rubber . . . duck . . . canvas . . . cork . . . felt . . . cardboard, etc., the "ALLPAX" cuts gaskets faster, cleaner and more accurately than is possible by any old fashioned hand method. Furthermore, it will cut gaskets from 1" to 36" in diameter with any width flange.

SAVES MATERIAL, TIME AND LABOR.

In actual, every day service, the "ALLPAX" has shown savings of 25% in material plus a tremendous saving in time and labor.

MADE IN U.S.A. BY A PACKING MANUFACTURER FOR PACKING USERS.

Because ALLPAX knows the problems that confront packing users, our engineers were well qualified to develop a Gasket Cutter that would meet all requirements in a way that would be an outstanding improvement over old methods. Reports from hundreds of users as well as wider and wider recognition and acceptance everywhere confirm all claims made by us that the "ALLPAX" is one of the most remarkable tools ever invested" . . . and can be used with outstanding advantage wherever packing is cut for application.

COMPLETE . . . READY TO USE.

The ALLPAX GASKET CUTTER is furnished complete with six (6) double-edge cutting blades and one (1) 18" varnished wood cutting board . . . all packed in a convenient, durable hardwood case with hinged cover . . . everything needed and ready for any job of gasket cutting. Price $19.50 for the complete equipment, f.o.b. Mamaroneck, N. Y. ORDER NOW!

30-DAY FREE TRIAL OFFER

USE COUPON FOR CONVENIENCE IN PLACING

THE ALLPAX COMPANY, INC.
Mamaroneck, N. Y.

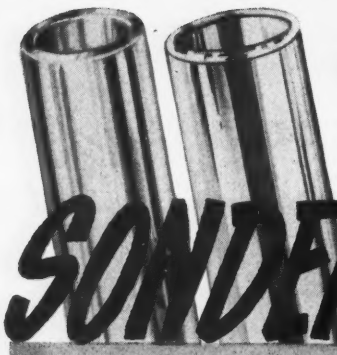
(Sole Distributors for Canada:
Atlas Asbestos Co., Ltd., 110 McGill St., Montreal, Canada)

Kindly send further information on the "Allpax Gasket Cutter"

Please enter my order and ship.....Allpax Gasket Cutter (s)

Name ..... Company.....

Street Address ..... City..... Zone..... State.....



Reduce Blowout Hazards and Expense with

SONDERGLASS

"THE UNBREAKABLE GAUGE GLASS"

In repeated tests SONDERGLASSES have been dipped in hot oil at 450 deg. F, then quickly plunged in cold water without breaking. . . . Besides reducing the hazards and danger of flying glass, SONDERGLASS gives better visibility, lasts longer, costs less per year of service than ordinary boiler gauge glasses. . . . Order SONDERGLASS —which engineers call "The Unbreakable Gauge Glass"— from your steam supply man or directly from us.

A. W. CHESTERTON CO. • 64 INDIA ST., BOSTON 10, MASS.
Distributors in Principal Cities

Comes in two popular types: CLEAR for use where water column is well lighted; REFLECTING with red and white enamel background to make water level visible as a bull's eye.

"Boiler Repairs Reduced 75%"
writes user of NATIONAL GIRTH SEAM PROTECTOR

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 928-29 REIBOLD BLDG., DAYTON, OHIO

G.E. GETS ORDER FOR 132 KV OIL PIPE CABLE

ANNOUNCEMENT OF an order totalling approximately $350,000 for cable and accessories for an underground transmission line for the city of San Antonio has been made by the Wire and Cable Division of the General Electric Co.

HELPFUL BULLETINS

(*Continued from page 54*)

43 **Wire and Cable Bulletin**—A new illustrated bulletin describing this company's principal types of heat and corrosion resistant wires and cable has just been issued. It is Bulletin OK-2061. This booklet has been prepared to present an overall picture of a group of products each insulated with impregnated felted asbestos and designed to transmit electrical power uninterruptedly where high temperatures are encountered in continuous service. Cutaway illustrations of each type of wire and cable are presented in order to show method of applying insulation. Four useful tables of current carrying capacities and recommended voltages and service conditions also are given. The Okonite Co.

44 **Gauge Glass Protector**—This four-page bulletin tells all about the company's gauge glass protector. A series of four photographs picture the unit taken apart, partially assembled and completely assembled. List prices are given and instructions for installation and a list of the unit's advantages are presented. Wright-Austin Co.

45 **Drills—How To Sharpen Them**—In order to help the user obtain the maximum cutting performance from his twist drills this company has prepared a 24-page guide (Manual G-1) to correct point grinding and web thinning. Right and wrong drawings and photos are used extensively to clarify the description and auxiliary information includes tables and drawings of recommended drill points for various materials. The bulletin also tells about four other booklets which the company has made available for users of drills. Republic Drill & Tool Co.

46 **New Abrasive**—There are four pages in this new bulletin and they are devoted to a description of the characteristics and advantages of "32 Alundum," a new abrasive material developed by this company. The bulletin is printed in three colors and presents several illustrations of the various forms in which this abrasive is available. A listing is also given of what the abrasive is and another one which tells what it does. Norton Company.

47 **Preformed Wire Rope**—This is a comprehensive 24-page book in color entitled "Preformed Wire Rope—What it is—What it does." The book tells the story of the development of preformed wire rope and what its development has meant to all industry. It tells what preformed wire rope is, what it means to management, what it means to workers, is profusely illustrated with photographs of actual installations, and contains a chart showing where wire rope is applicable in various types of plants and industries. The last page is an index for easy reference. Preformed Wire Rope Information Bureau.

48 **Hose**—Two new catalog sections for loose-leaf filing are now available. Catalog Section 4600 covers suction hose for excavating and general utility service. This is a four-page leaflet with illustrations describing the company's Spiralock construction which provides a smooth bore, lightweight and easy to bend hose. This hose is recommended for any degree of suction and for discharge pressures up to 30 psi. Two-page catalog section 4800 describes high duty water hose, Jupiter water hose, Brown brand water hose, deluge water hose and jetting hose and gives tables of sizes, plies, working pressures, etc. The B. F. Goodrich Co.

49 **Try-Cocks Bulletin**—Bulletin WG-1815 is a 4-page piece which completely describes the company's Sealtite try-cocks. Two types are shown—weight-operated and lever-operated; a cutaway view shows the interior construction of the unit. A quotation from the ASME power boiler code is presented to illustrate the need for these devices and their operation is outlined in detail. Dimensions, prices and parts lists are given on the last page of the folder. Yarnall-Waring Co.

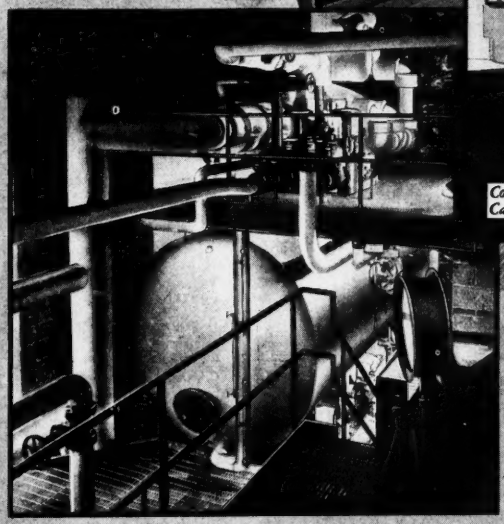
50 **Vertical Motor**—2-page Bulletin SL-300-3 just issued describes protected-type motors designed for close coupling to centrifugal pumps, agitators, atomizers and many types of machine tools. The bulletin contains drawings and dimensions of the NEMA "B" flange and NEMA "C" face mountings in frame sizes up to and including 326. Among the features described in this new bulletin are a recessed junction box, dynamically balanced Alucast rotor and coils protected by Vinylastic insulation. Crocker-Wheeler Electric Mfg. Co. Div. of Joshua Hendy Iron Works.

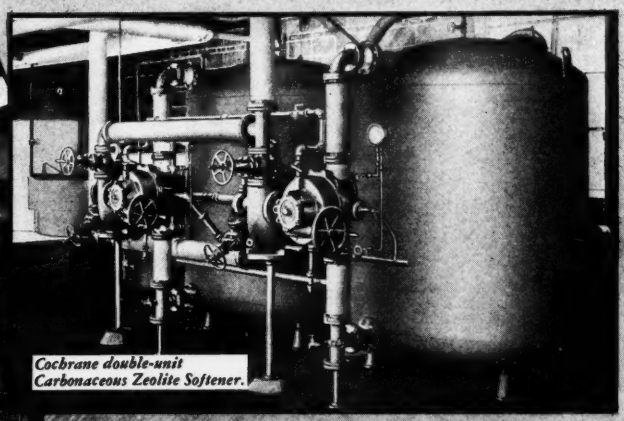
(*Turn to page 162*)

CLEAN COOKING STEAM for Seabrook Farms

DEERFIELD PACKING CORP. with COCHRANE WATER CONDITIONING

(Below) Cochrane Deaerating Heater which removes dissolved oxygen and corrosive gases from feedwater.





Cochrane double-unit Carbonaceous Zeolite Softener.

AT SEABROOK FARMS, operated by the Deerfield Packing Corp. at Bridgeton, N. J., the boiler feedwater conditioning system furnishes 100% boiler feed requirements, little condensate being returned to the boilers, as most of the steam is used in direct contact with the food products.

How water is softened—Raw water with 30 to 40 ppm. of calcium and magnesium hardness is pumped to two Cochrane carbonaceous zeolite softeners. These softeners operate for about two days between regenerations, an ingenious device indicating when the zeolite beds are exhausted. A horn and a signal light on the boiler control panel warn the engineer who then confirms need for regeneration by testing for hardness.

Deaeration—After softening, the feedwater flows through the heat enchanger of the Cochrane Continuous Blow-Off System, where it absorbs the residual heat of the concentrated boiler blow-off water and then passes through the vent condenser into the Cochrane deaerating heater. Here the dissolved oxygen and carbon dioxide are removed preventing corrosion of piping and boiler tubes. From the storage tank of the deaerator, the softened and deaerated water is pumped to the boiler. • After one year of continuous service at full boiler capacities, internal boiler inspection revealed no evidence of corrosion or scale, proving the perfect functioning of the Cochrane water conditioning equipment.

COCHRANE
SINCE 1863

The equipment employed at Deerfield is described in Cochrane Publications 4021, 3005 and 4081. Copies will be mailed on request.

COCHRANE CORPORATION
8123 N. 17th St., Philadelphia 32, Pa.

Pea-harvesting operations at Seabrook Farms. New power house in background.

CATALOG LIBRARY

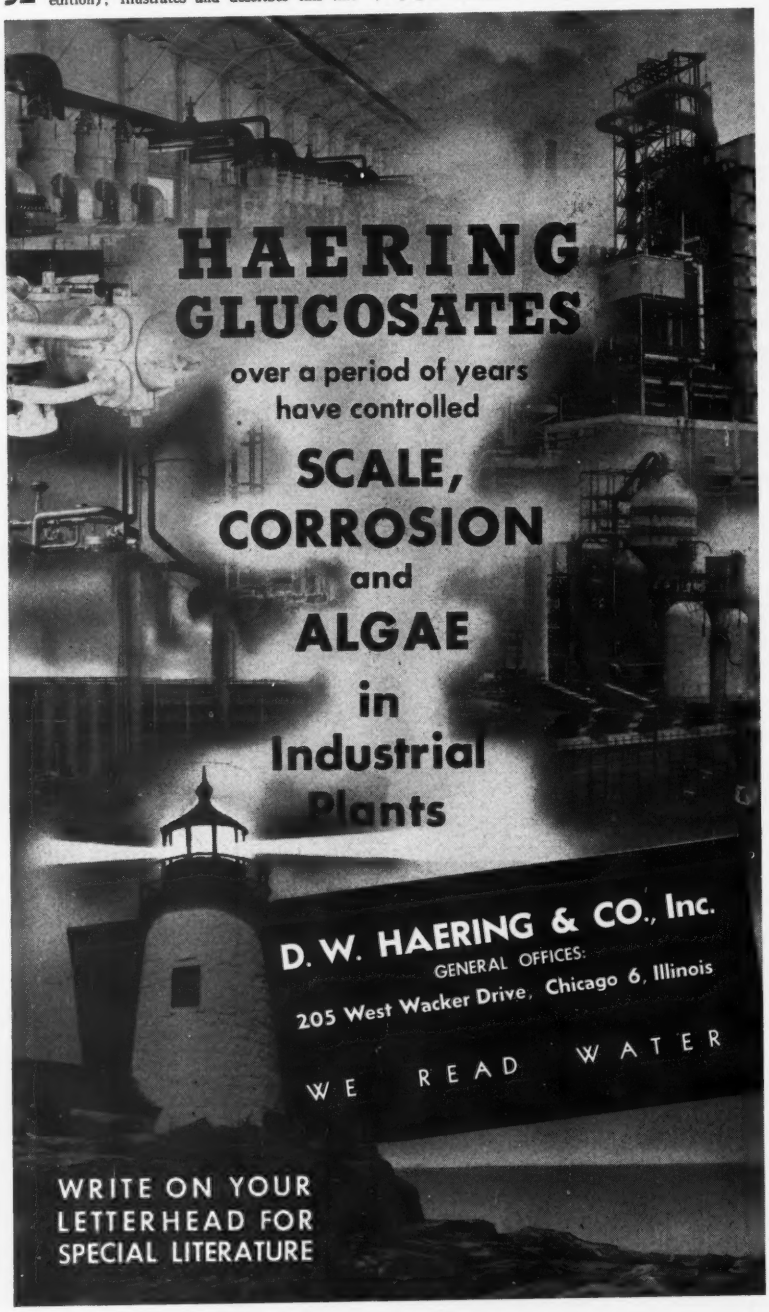
This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS

51 **Steam Generators**—Catalog almost completely devoted to cross-sectional drawings with accompanying listing of principal data of typical installations in rubber companies, steel works, sugar refineries, municipal plants, etc. Details of furnace water wall construction on inside back cover; 16 pages. Henry Vogt Machine Co., Inc.

52 **Double-Pass Boilers**—Bulletin RM-1 (6th edition); illustrates and describes this line of riveted or welded double-pass steel firebox boilers. Three full pages of dimensions, ratings and other details including dimensioned line diagrams; 8 pages. The Brownell Co.

53 **Boilers, Burners, Accessories**—Bulletin GC-10; condensed catalog of regular products for stationary power plants. Each class of equipment summarized and illustrated. Well illustrated with line drawings and photographs. Illustrations accompanied by brief descriptions; 12 pages. Combustion Engineering Co., Inc.



54 **Standardized Boilers**—Bulletin 746; 4 page bulletin presenting construction and operation information and ordering specifications for this company's Type M boilers. Bulletin illustrated, presents table of measurement and data. Springfield Boiler Co.

55 **Steam Generator**—Bulletin 119; company's Type S steam generator described and features of construction are pointed out. Folder well illustrated and dimensioned drawing and table of dimensions and sizes given. Union Iron Works.

PRIME MOVERS

56 **Wheel Turbines**—Explanation of 14 advantages; diagrammatic illustrations and explanations of operation; 8 pages. Terry Steam Turbine Co.

57 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. Terry Steam Turbine Co.

58 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

59 **Steam Engines**—Bulletin No. 306; Engineering data; tabular material, descriptions; 8 pages. Troy Engine & Machine Co.

60 **Generating Sets**—Bulletin No. 108; General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

61 **Stationary Diesel Engines**—Dependability, adaptabillty of Diesel power described and the first five applications pointed out. Its economical and simple design is stressed. Advantages of company's equipment brought out; exceptionally well illustrated; 24 pages. Enterprise Engine and Foundry Co.

AUXILIARIES, ACCESSORIES

62 **Strainers and Separators**—Bulletin 46-50; describes complete line of company's strainers and separators. Dimensions and price lists, dimensioned drawings and photographs; tables of sizes and complete description of applications, operation and design; 16 pages. American District Steam Co.

63 **Atomizing Deaerators**—Bulletin 4160; 3 color drawing illustrates description of principle of operation. Advantages of deaerators are described and illustrated; marine deaerators also covered; 20 pages. Cochrane Corp.

64 **Steam Condensers**—Bulletin 1461 "Steam Condensers"; exceptionally well illustrated with line drawings, charts and photographs. Large proportion of the catalog devoted to engineering information such as calculations of required surface, atmospheric relief valve sizes, tube characteristics, free dry air leakage, pressure-temperature conversion tables and tables of logarithms; 46 pages. C. H. Wheeler Mfg. Co.

65 **Condensate Return System**—Description of operation and possible savings accompanied by line diagram and description of how "Jet-Loop" works; typical installations pictured and described. Drawings and text show proven results from experience of users. 2 page spread of drawings and table of dimensions; 16 pages. Cochrane Corp.

66 **Low Pressure Evaporators**—Description of L. P. evaporators; types of evaporator plants, listing of advantages of L.P. submerged tube evaporators. Line diagrams illustrate principles brought out in descriptions. Typical installations are considered and analyzed; 12 pages. Condenser Service and Engineering Co., Inc.

67 **Power and Industrial Equipment**—Bulletin Q-12; describes and illustrates company's equipment for power and industrial use—steam turbines, motors, generators, feedwater heaters, turbo-chargers, steam jet ejectors, centrifugal blowers. Exceptionally well illustrated; 20 pages. Elliott Co.

68 **Heat Exchanger**—This new bulletin describes the company's Twin G-Fin Section; Bulletin 1614; section characterized as universal heat exchanger. Bulletin tabulates 21 features and corresponding advantages, describes design and construction. Installation views shown, field reports included; 16 pages. The Griscom-Russell Co.

69 **Evaporators**—Bulletin 364 describes, illustrates evaporators for various capacities and pressures; contains sections of special interest to plant engineers and executives; includes explanation of functions of evaporators, benefits obtained by their use; different types of evaporator systems and their association with plant heat balance. Bulletin well illustrated and presents heat flow diagrams of plants; 26 pages. The Griscom-Russell Co.

70 **Soot Blowers**—Bulletin F45; soot blowers in general are described. Description and operation of units, materials and specifications and other pertinent information is presented; tables of steam consumption, boiler efficiency, fuel saving chart; boiler cross-sections with blower locations

L-O-N-G ON LINE···
L-O-N-G ON LIFE

To get the *right* valve for your particular installation, take your pick from OIC's *l-o-n-g* line. It includes bronze, iron and steel valves in a wide variety of trims. Sizes, types and pressure classes are available to fit most services.

To get *long life* from the valves you buy, pick the ones with the OIC trademark. That symbol means heavy construction . . . extra "beef" at vital points such as body walls, heavily-ribbed yoke arms, full-threaded bonnet bolt studs and sturdy I-beam wedges. It means quality materials and precision manufacture that assure you an extra margin of safety . . . with a smaller amount of maintenance. You can *trust* the products of OIC — pace-setter in valves!

WE'LL BE GLAD TO SEE YOU AT OUR EXHIBIT AT NEW YORK POWER SHOW, BOOTH 58

OIC
SETS THE PACE
IN VALVES

OIC VALVES
Steel Iron Bronze

Distributors In Principal Cities

248 PAGES OF VALVE DATA
Now coming off the press, this useful new OIC catalog is crammed with facts and specifications on steel, iron and bronze valves. Demand is already large, so mail the coupon to *reserve your copy NOW!*

MAIL THIS RESERVATION TODAY!

Ohio Injector Company—Wadsworth, Ohio

Please save me a copy of the new OIC valve catalog and data book.

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indicated thereon and installation drawings and data are included; 30 pages. Marion Machine, Foundry & Supply Co.

71 **Water Heater Capacity Ratings**—14 tables are included in this ratings booklet showing capacity ratings per hour for temperature rises of from 20 deg (50 to 70 deg) up to and including ratings for a 150 F temperature rise (50 to 200 F). Table No. 15 presents the rate of flow of steam through pipes with steam from an initial gage pressure of one pound up to 150 psi. Marion Machine, Foundry and Supply Co.

72 **Fin Coils for Cooling**—Bulletin 120; directions for ordering fin coils, description of coil features, tables of dimensions, ratings, shipping weights, list prices of ceiling coils, storage coils, etc. Baffling, overhead blower units, custom built air conditioning coils and other equipment described and illustrated; 20 pages. Kempe Co.

73 **Air Ejectors**—Bulletins M-300 and M-301; what they do; types, blueprint type drawings, tables of sizes, manufacturing facilities and equipment; total 16 pages. The Lummus Co.

74 **Coal Weighing Scales**—Description; outstanding features, specifications, line drawings, photos; 4 pages. Beaumont Birch Co.

75 **Rack and Pinion Gates for Coal and Ashes**—Ball-Bearing, dust-tight features; photos, specifications, drawings, tables of dimensions; 4 pages. Beaumont Birch Co.

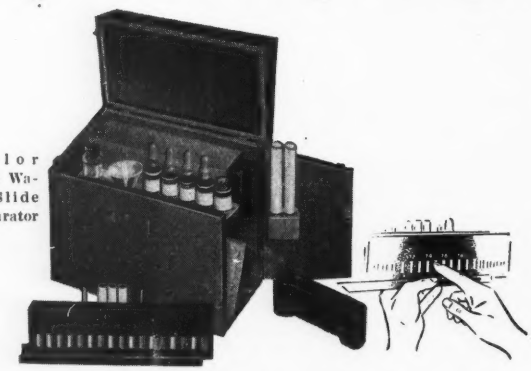
76 **Steam Specialties**—Collection of folders; steam trap, air trap, reducing valves, classes E, B and H pump governors, automatic boiler feedwater controller; parts and unit list prices; descriptions; illustrations; tables of capacities. The C. E. Squires Co.

77 **Deaeration**—Data book; No. N-15; gives reasons for and principles of deaeration; cold water deaeration; tabular drawing and chart material presented; well illustrated; 20 pages. Elliott Company.

78 **Power Plant, Industrial Process Equipment**—Steam turbines, turbine generators, mechanical drive turbines; motors and generators; feed-water heaters and deaerators; condensers and auxiliaries; steam jet ejectors; centrifugal blowers; turbochargers for diesels; accessories and tube cleaners; completely illustrated; 20 pages. Elliott Company.

79 **How to Choose a Steam Trap**—Trap selection, trap rating, trap capacity factors, individual trapping, determining lift; traps for unit heaters, pipe coils, fan system heating surfaces, steam jacketed kettles, autoclaves, laundry equipment, paper makers, etc.; installation, operation, maintenance, instructions; specifications and capacities; corrosive service; 42 pages. The V. D. Anderson Co.

Keep Boiler Output High!



Taylor Boiler Water Slide Comparator

Check Your Boiler Water with
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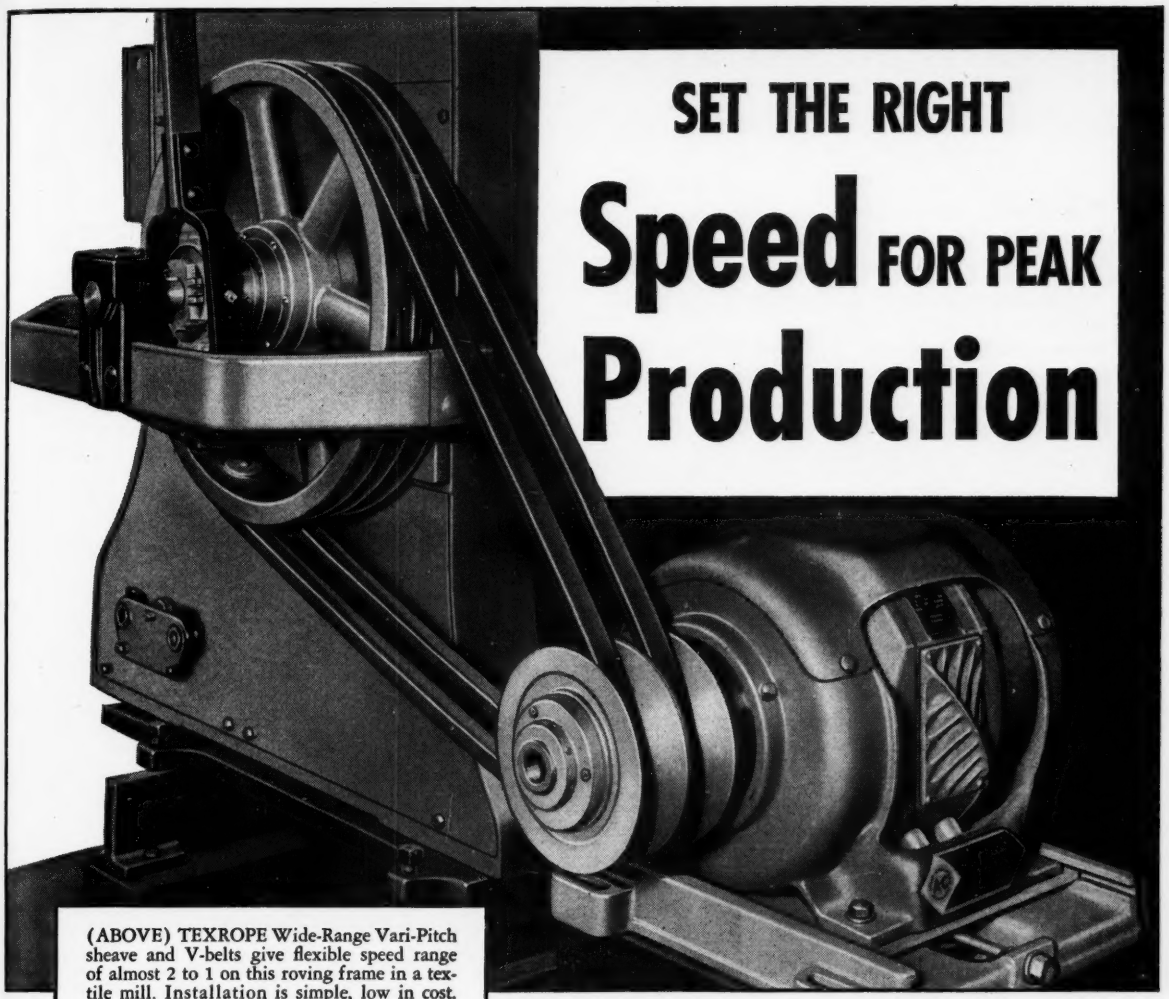

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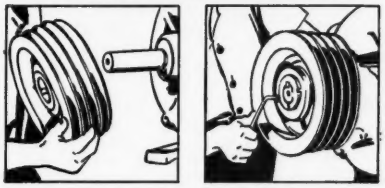

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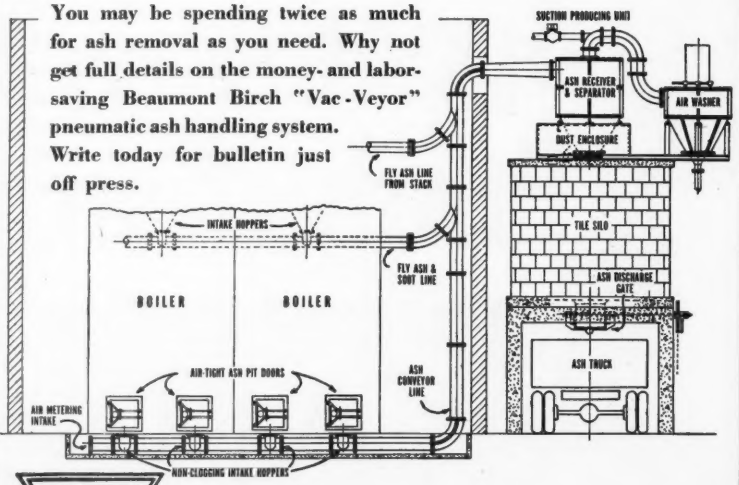

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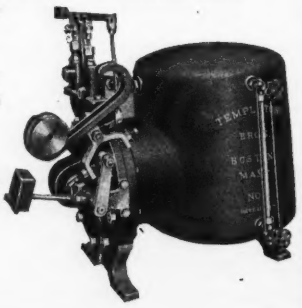

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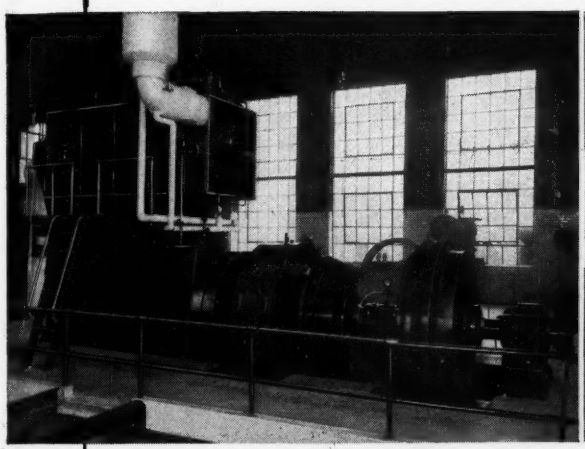

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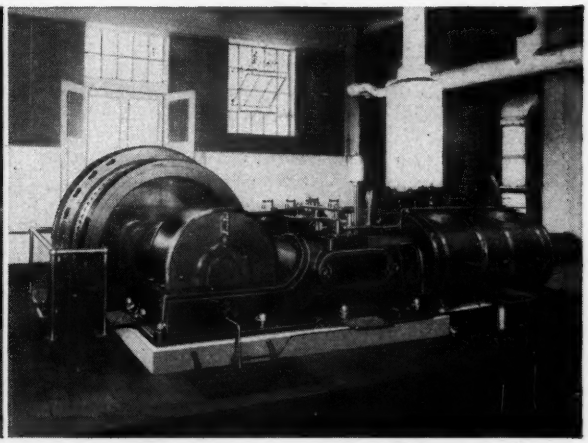

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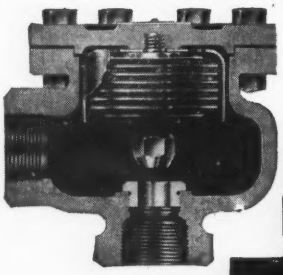

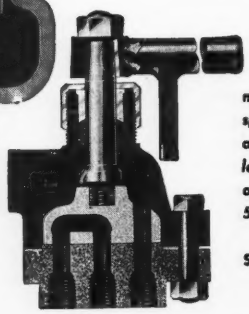

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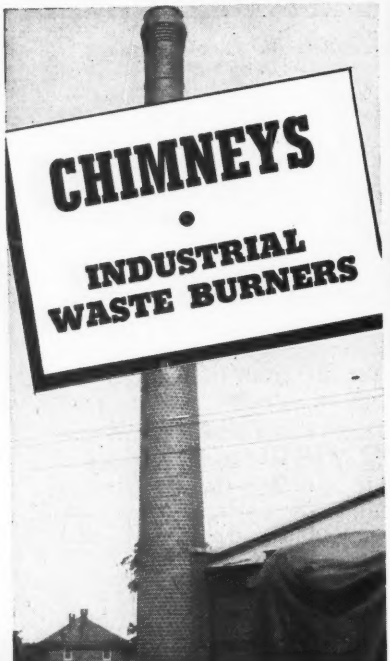

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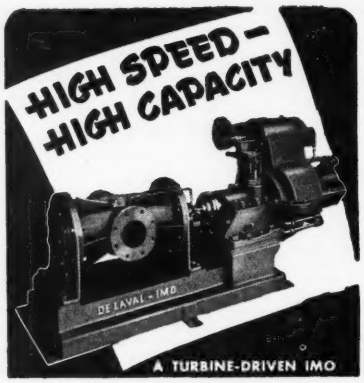

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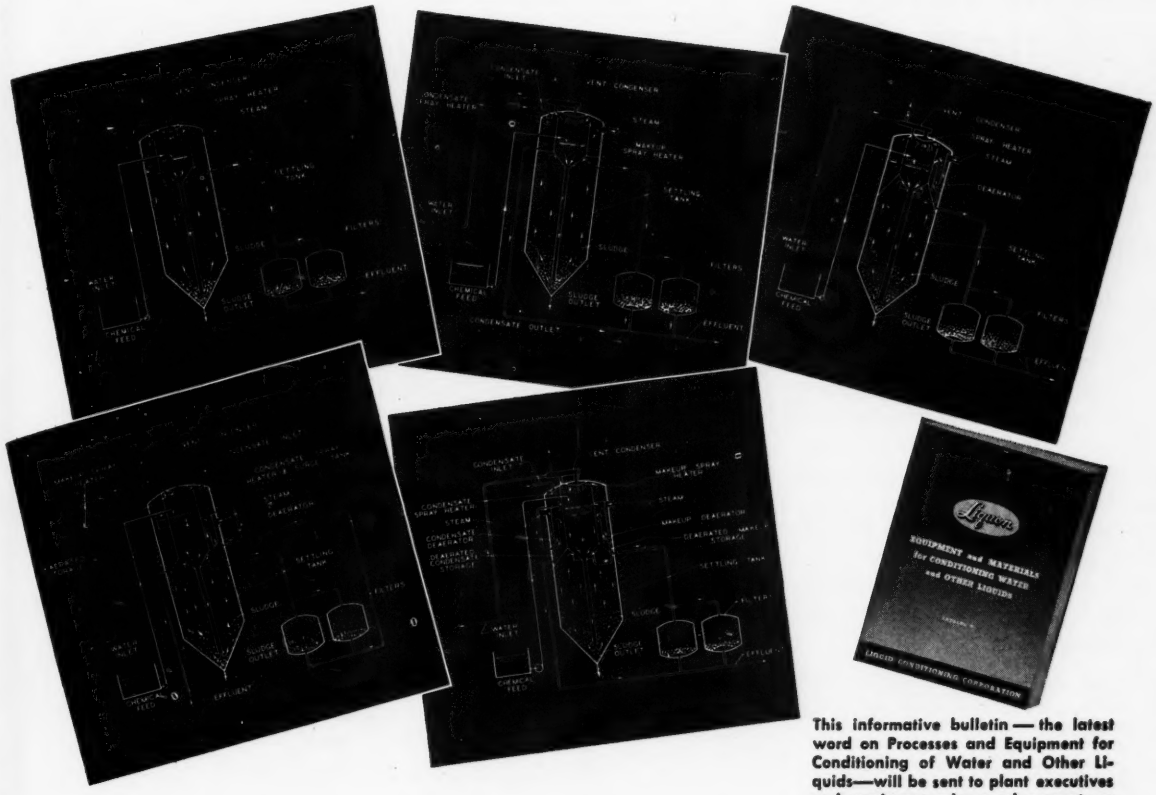

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147 **Indicating, Control Systems**—What they are, what they can do; Bulletin 14B6641. Description of how transmitter, receiver and indicator of systems are constructed, how they work, their advantages and specifications. Illustrated with photographs, diagrams, charts; 12 pages. Allis-Chalmers Mfg. Co.

148 **Water Gages**—Condensed catalog, Bulletin E, of company's complete line of water gages. Each model illustrated and accompanying table gives sizing information; 8 pages. Ernst Water Column & Gage Co.

149 **Pyrometer Buyers' Guide**—Bulletin 100-1; illustrated table of contents, directions for selecting proper thermocouples, charts and diagrams. Detailed information includes complete description of material for assembled thermocouples and components; prices are listed; 40 pages. Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co.

150 **Stainless Steel Bellows**—Bulletin SSB-46; contains diagrammatic cross-section views and up-to-date information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors, for flow control, vapor and steam traps, thermostatic instruments, etc. Completely illustrated; 12 pages. Chicago Metal Hose Corp.

151 **Pitot Equipment**—Three section Bulletin 50; gives complete details of the use of Pitot tubes and rods, instructions in the use of the company's portable Pitot recorder, together with theory, formulae, notations and curves. Completely indexed; 20 pages. Simplex Valve & Meter Co.

152 **Manometers**—Bulletin 200; describes completely this line of fixed and portable manometers for use in water surveys and similar flow rate measurement, valuable engineering data also included. Illustrations include line drawings and photographs; 8 pages. Simplex Valve & Meter Co.

153 **Instruments, Controls for Process**—Bulletin 17; process controllers, control components, measuring components and instrument combinations briefly described and illustrated. Application data such as sizes, pressure standards and ranges are listed; 8 pages. Bailey Meter Co.

154 **Temperature Regulators** — Bulletin 7-A; six types; descriptions, list prices, tabular material, photos; list of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

155 **Feed Water Regulator**—Bulletin 8-A; description of operation; cycle of operation; full-page installation drawings; instructions for installing regulators; list prices and parts lists; 14 pages. Atlas Valve Co.

156 **Temperature Regulators**—Bulletin 6-A; for hot water heaters, storage tanks, etc.; what they do; operation; regulation; descriptions and drawings; list prices; applications; dimensioned drawings; installations; 20 pages. Atlas Valve Co.

157 **Draft, Excess Air and CO_2**—Bulletin 39-341; discussion of the relation of these elements to the installation and servicing of bituminous and anthracite stokers by Arnold Soller; 12 pages. The Hays Corp.

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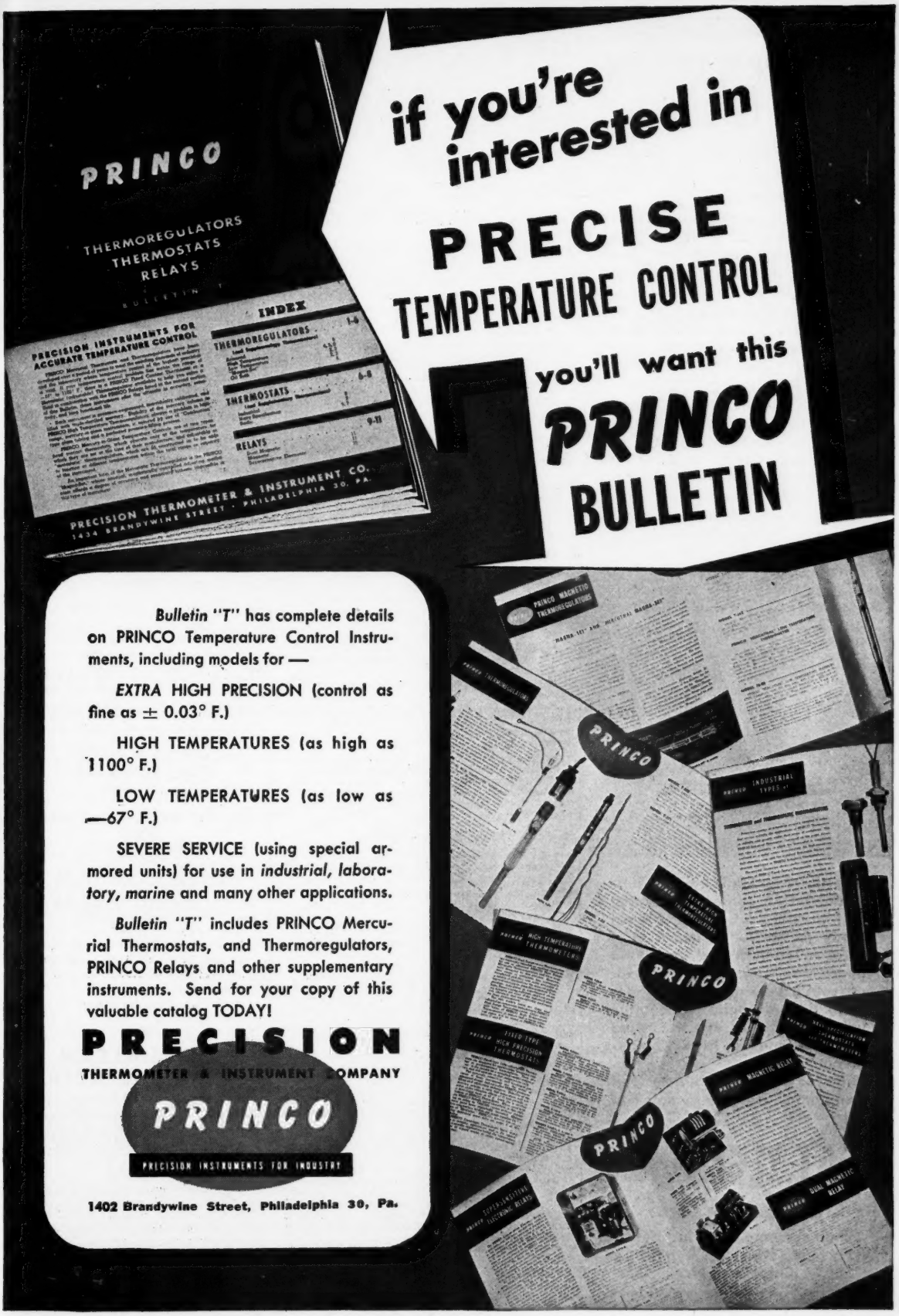
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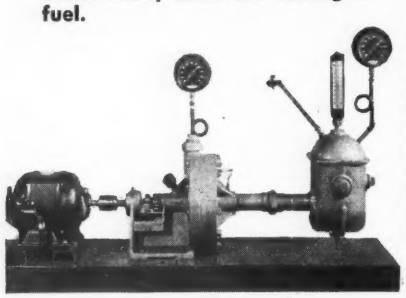

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158 **Packings, Gaskets**—Full-page descriptions of each type of packing, plunger rings, pump valves, sheet packing, gaskets; installation and maintenance; engineering data and tables, conversions and equivalents; complete indexing; 64 pages, board cover. Sea-Ro Packing Co.

159 **Packings**—Bulletins P3, P14, P25 and P22; descriptions, tables of size and size number; tables of service for various packings; prices; 18 pages total. Greene, Tweed & Co.

FITTINGS

160 **Standards for Flanged Fittings, Valves, Flanges**—Pressure-temperature ratings, tables and charts, rating procedure, flange materials, safety factors, loading, stress formulas; 20 pages. Tube Turns, Inc.

161 **Welding Fittings**—Allowable working pressures; power, oil, district heating, refrigeration, gas and air piping; 14 tables and directions for use; 18 pages. Tube Turns, Inc.

162 **Welding Fittings**—Volumetric capacities; 2 pages of formulas for computation of capacities; 6 pages of tables; 12 pages in book. Tube Turns, Inc.

163 **Reference Tables and Data**—Bulletin 406; properties of saturated steam; velocities for fluid flow through pipes; saturated steam capacity of pipe; dimensions of extra-strong pipe; areas of circles and gal per ft of cylindrical length; engineering computations; 4 pages. Leslie Co.

164 **Unions**—Complete line of malleable iron unions and convenience unions; illustrations, descriptions, size and list prices; descriptions of materials and workmanship; 24 pages. Jefferson Union Co.

PUMPS

165 **Horizontal Duplex Piston Pumps**—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions, drawings, tables; 4 pages. Warren Steam Pump Co., Inc.

166 **Steam Heat Vacuum Pumps**—Bulletin 226-1; specifications, drawings, general information, tables of sizes and capacities; 4 pages. Warren Steam Pump Co., Inc.

167 **Centrifugal Pumps**—Bulletin 302-30, Revised; instructions for installation and operation; drawings, tabular material; 12 pages. Warren Steam Pump Co., Inc.

168 **Hydraulic Pressure Pumps**—Bulletin 238; specifications, sectional photos, important features; full page table of capacity, sizes, pipe sizes, pressures; 4 pages. Warren Steam Pump Co., Inc.

169 **Horizontal Duplex Plunger Pumps**—Bulletin 239; tables of sizes, capacities; important features, specifications; 4 pages. Warren Steam Pump Co., Inc.

170 **Controllable Capacity Pumps**—Data book 65; description, general design, method of operation; automatic control of pump delivery; drawings; adaptations, applications, power cost tables; standard sizes and ratings; 8 pages. The Aldrich Pump Co.

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172 **Valve Reseating Equipment**—Descriptions and photos; sizes and capacities; features; four pages. The Leavitt Machine Co.

173 **Lathe Chucks**—Features; sizes, capacities, price table; dimensions. The Leavitt Machine Co.

174 **Whistles and Signals**—Bulletin 421; for industrial, marine, railroad service; selection; construction; advantages; operation; ordering and specifying; 8 pages. Leslie Co.

175 **Electric Tools**—Bulletin 464; covers complete line of portable electric tools for construction and maintenance. 40 page bulletin illustrates and briefly describes such tools as electric hammers, drills, chisels, vibrating tools, accessories, screw drivers, etc. Prices are given. Syntron Co.

176 **Refractory Concrete**—"Lumnite for Refractory Concrete"; basic information on materials and methods used in making refractory concrete. Illustrations show application of concrete in construction of furnaces, coke ovens, etc. Another section covers concrete use in foundations, floors and structures subject to high heat; 24 pages. The Atlas Lumnite Cement Co.

177 **Gas Purger for Refrigeration System**—Bulletin 160; tells how to cut power costs and raise condenser capacity by proper purging of non-condensible gases. Tables of ammonia properties, description of equipment, listing of equipment's advantages and complete illustrated material. Typical installations are pictured. Two pages with diagrams tell how purger operates; 8 pages. Armstrong Machine Works.

178 **Grinding Wheels**—Grinding wheels of various abrasives are illustrated and list prices presented; tables of sizes in inches are accompanied by photographs and line drawings of these various wheels. Grinding wheel dressers with list prices are shown; 32 pages. Norton Co.

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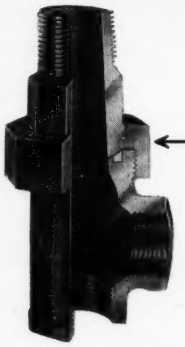

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More than 6 years ago the Foster 38-SV Safety Valve was developed especially to meet the trend toward higher operating pressures and temperatures.

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A few of the advances: constant popping point regardless of changes in temperature; full opening practically instantaneous with less than ½% accumulation; tight closing as little as 1% below popping point; blow-down adjustable as low as 1%.

Since the first installation early in 1940, more than 100 Foster 38-SV Safety Valves have been working at pressures up to 2575 pounds and at temperatures up to 1000° F. And during the war, all we could make went into installations vital to the war effort.

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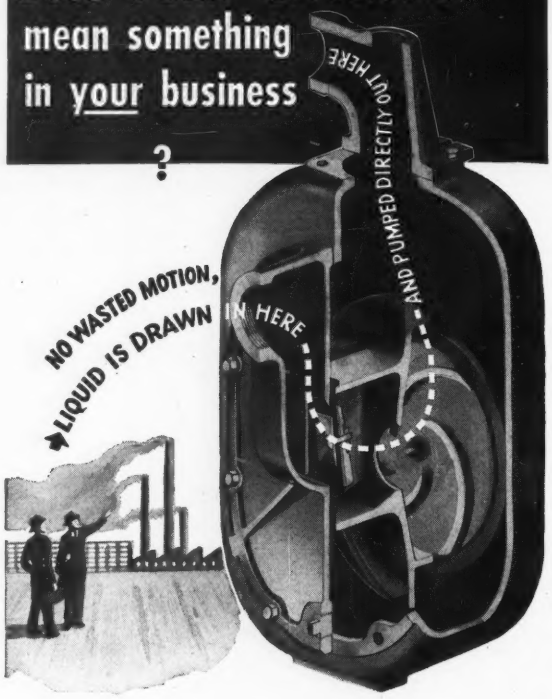

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5. Reliable for continuous or intermittent service; primes itself whenever necessary.
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7. 1½ to 10-inch sizes. 50 to 4000 gallons per minute.

Ask for Complete Interesting Information.

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POWER PLANT *Construction News*

Calif., Los Angeles—National Standard Co., 6943 Stanford Ave., wire goods, small springs, etc., plans installation of electric power equipment in new one-story addition, 72 x 220 ft. Cost estimated over $120,000, with machinery. Main offices are at Niles, Mich. Proposed to begin work in near future.

Fla., Fort Pierce—Electric Dept. has plans under way for extensions and improvements in municipal steam-electric power plant. Additional equipment will be installed for increased output. Fund of $750,000 has been authorized for this and extensions in water system. Smith & Gillespie, 221 West Adams St., Jacksonville, Fla., are consulting engineers.

Ga., Columbus—Georgia Power Co., Atlanta, Ga., plans new power substation at Columbus, with transformers, switchgear and auxiliary equipment for large capacity. Also will make extensions and improvements in existing substation at same place. Cost about $500,000.

Ill., Franklin Park—National Metal Products, Inc., 9301 West Belmont Ave., metal goods, plans installation of electric power equipment in new one-story plant, 100 x 220 ft., on local site on River Rd. Cost over $175,000, with machinery. Proposed to begin work soon.

Ind., Columbus—Bd. of Hospital Trustees, Bartholomew County Hospital, plans addition to boiler house at institution, with installation of new high-pressure boiler, steel stack and auxiliary equipment. It will be used for central-heating service. Norman H. Hill, Indiana Trust Bldg., is architect, and J. M. Rotz Engineering Co., Merchants' Bank Bldg., consulting engineer, both Indianapolis.

Ind., Kokomo—Haynes Stellite Co., metals, plans installation of electric power equipment in new one-story mill, reported to cost in excess of $500,000, with machinery. Work scheduled to begin in near future.

Kan., Iola—Municipal Electric Dept. has tentative plans for expansion and improvements in steam-electric power plant, with installation of additional equipment for larger output. Special election will be held to approve bond issue of $415,000 for program.

Mass., Indian Orchard—Monsanto Chemical Co., plans new boiler house at local plastic products plant. Work on steel frame superstructure will be placed under way soon. Cost reported in excess of $100,000. Main offices are at 1700 South Second St., St. Louis, Mo.

Mass., Northampton—Bd. of Trustees, Smith College, has plans for new boiler house at institution for central-heating service. No official estimate of cost announced but reported over $100,000. Proposed to begin work in near future.

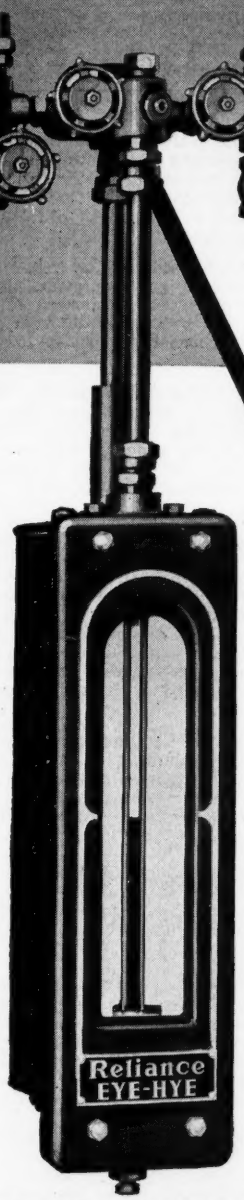
Mich., Grand Rapids—Consumers Power Co., Jackson, Mich., has authorized plans for new power substation at Grand Rapids, reported to cost over $500,000, with equipment. Proposed to begin work in near future.

Mich., Scottville—Western Michigan Electric Corp., Scottville, has plans for expansion in local Diesel-electric generating station. New generating unit and accessory equipment will be installed. No official estimate of cost announced. J. & G. Daverman Co., Keeler Bldg., Grand Rapids, Mich., are architects.

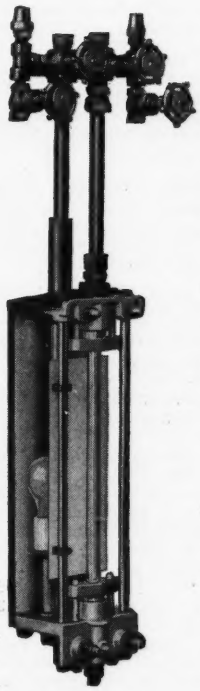
Minn., Benson—Western Minnesota Power Cooperative, Inc., Benson, E. L. Smith, president, plans new local power plant, using Diesel engine-generator units. Capacity about 1000-kw. Cost reported close to $500,000. A similar power station of smaller rating is also planned at Granite Falls, Minn. Financing is being arranged through Federal aid. General Engineering Corp., 2950 Chicago Ave., Minneapolis, Minn., is consulting engineer.

Newly Styled— Newly Engineered

Reliance EYE-HYE gives you full assurance of safe, accurate boiler water level reading *wherever you want it . . .*



Newly engineered, the EYE-HYE is more compact than previous models—has added features of special value. Cover is removed by unscrewing four acorn nuts . . . making interior easily accessible for replacing lamp or cleaning the gage. The new case is water-proof, protecting illuminating element from any overhead dripping. Handsome cover plate bolts to face of panel board, or entire unit is bolted to girder or wall through mounting flanges at back.



You probably know the EYE-HYE, through observation or through actual use. Power engineers everywhere have watched the progress of this remote reading gage—a new idea ten years ago—now widely used in both stationary and marine power plants.

Your high-on-the-boiler water gages are brought down to eye level—your supervision of water levels is more confident—with this simple, positive, foolproof device. Water level image shows bright and clear, in green indicating fluid (illuminated), the EYE-HYE window unit placed prominently on panel board or other convenient mounting. It reads like the water gage on the drum—a column of liquid. Connections are simple—two lines of flexible tubing easily installed to constant head reservoir at the drum (an accessory device supplied with EYE-HYE).

EYE-HYE is now restyled—re-engineered. First new model announced, E-32, is adaptable to pressures up to 400 lbs. Other new models will soon be ready, for pressures to 2000 lbs. Today's EYE-HYE is more compact, has greater pressure range per model, shows modern design. Its calibration is fixed for your particular requirements; cannot be tampered with in service.

Plan to add EYE-HYEs to your boiler equipment, for the greater efficiency of remote water level supervision guaranteed by simple, hydrostatic action. Write for latest information.

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IRON CEMENT

Minn., Owatonna—Public Utilities Dept., 208 South Walnut St., has plans nearing completion for extensions and improvements in municipal steam-electric power plant, including installation of new 4000-kw. turbine-generator unit, 7000-sq. ft. condenser and auxiliary equipment. Pfeifer & Schultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

Minn., Winona—Mississippi Valley Public Service Co., East Third St., plans extensions and improvements in local generating station, with installation of additional equipment for increased capacity. Estimates of cost are being made. Ward & Strand, 1 West Main St., Madison, Wis., are consulting engineers.

N. Y., New York—Consolidated Edison Co., Inc., 4 Irving Pl., has authorized expansion in gas-generating plant at Hunts Point, with installation of new water-gas sets and other equipment. Program will be carried out over period of several months, and is estimated to cost in excess of $6,000,000.

N. Y., Niagara Falls—E. I. duPont deNemours & Co., Electro-Chemical Dept., duPont Bldg., Wilmington, Del., plans installation of electric power equipment in new additions to plant at Niagara Falls, reported to cost about $3,000,000. Work will be carried out over a period of several months and will be placed under way soon.

Ohio, Bellaire—Ohio Public Service Co., Cleveland, Ohio, plans new steam-electric power plant in vicinity of Bellaire, with initial capacity of 100,000-kw. Also will make extensions in Edgewater generating station at Lorain, Ohio, with installation of new 65,000-kw turbine generator and auxiliary equipment. Present power plants at Mansfield, Marion and Warren, Ohio, will be extended and improved, with installation of additional equipment for increased capacity. Work noted is part of a five-year expansion program to be carried out by company, with total expenditure estimated at $27,000,000.

Ore., Eugene—City Water Bd. has authorized plans for expansion in municipal power plant, with installation of additional equipment to develop capacity of 42,000-kv., or practically double present rating. Cost estimated approximately $560,000. Work scheduled to be carried out early in 1947.

Ore., Medford—Northern Refrigeration, Inc., 401 South Fir St., plans new two-story cold storage and refrigerating plant, 75 x 185 ft., estimated to cost close to $100,000, with equipment. Proposed to begin work soon. L. H. Hess is president.

Pa., Courtney—West Penn Power Co., 14 Wood St., Pittsburgh, Pa., has tentative plans for new steam-electric generating station at Courtney, with turbine-generators, high-pressure boilers and auxiliary equipment for large rating. Cost reported close to $10,000,000. It is understood that work will begin early in 1947, with completion scheduled in 1948.

Tenn., Lowland—American Enka Corp., Enka, near Asheville, N.C., viscose rayon products, plans installation of electric power equipment in proposed new mill at Lowland, near Morristown, Tenn., comprising several one and multi-story buildings. A boiler house and pumping station will be built. Entire project is estimated to cost over $7,500,000. H. K. Ferguson Co., Hanna Bldg., Cleveland, Ohio, is engineer and building contractor. Completion is scheduled early in 1948.

Texas, Mineral Wells—Cannelton Sewer Pipe Co., Cannelton, Ind., sewer pipe, drain tile, etc., plans installation of electric power equipment in proposed new branch plant at Mineral Wells, where site has been acquired. It will comprise several buildings. A boiler house is planned. Entire project is reported to cost about $450,000.

Wash., Seattle—Zellerbach Paper Co., 1258 First St., South, tissue papers, wrapping papers, etc., plans installation of electric power equipment in proposed new converting plant at 6401 Airport Way. A boiler house will be built. Entire project estimated to cost about $350,000.

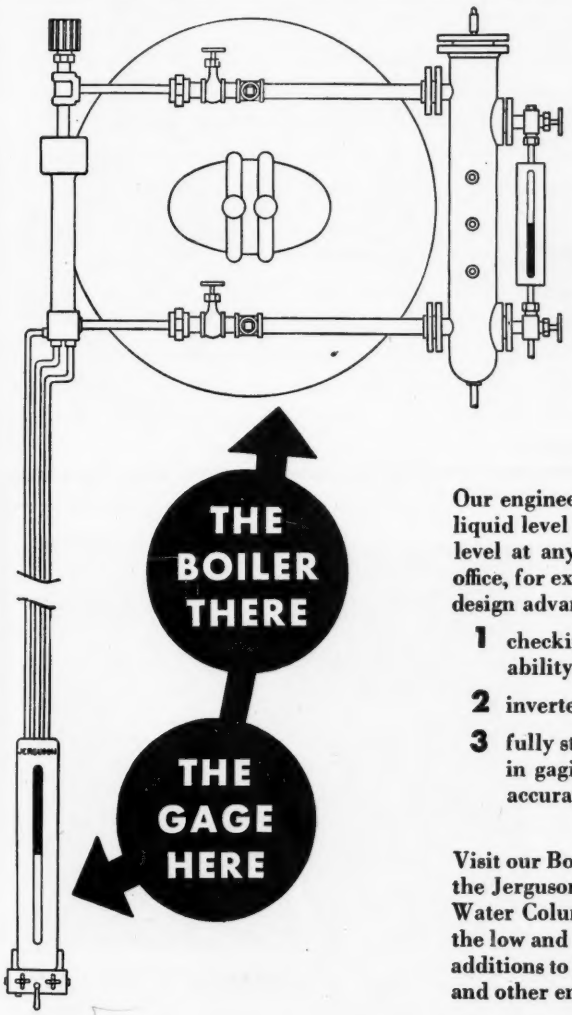
Wis., Wisconsin Rapids—Water Works and Lighting Commission has plans under way for new municipal power plant, estimated to cost about $800,000. Foth & Porath, 409 East Walnut St., Green Bay, Wis., are consulting engineers.

JERGUSON

DISTANT READING Liquid Level Gage

JERGUSON

"SOLID WEIGHT" Water Column



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Our engineers have come up with a really practical distant reading liquid level gage, one that provides accurate reading of boiler water level at any distant point... on the firing aisle or in the super's office, for example. Along with this obvious usefulness, it offers these design advantages:

1. checking level device to permit checking accuracy and operability of the unit while in operation
2. inverted U-tube principle, providing positive dirt trapping
3. fully steam-jacketed condenser to keep specific gravity of water in gaging unit similar to that in the boiler drum, resulting in accurate level indication at the gage.

Visit our Booth at the Power Show. We'll be glad to tell you all about the Jerguson Distant Reading Gage. Also about the unique Jerguson Water Column with its solid weights and greater leverage action at the low and high water alarm whistle. Both of these items are worthy additions to the extensive line of Jerguson Liquid Level Gages, Valves and other engineering specialties.

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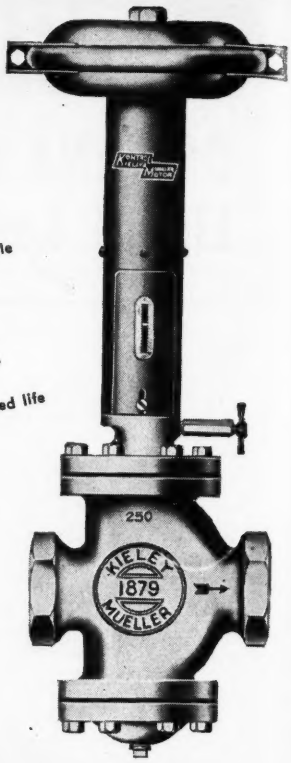

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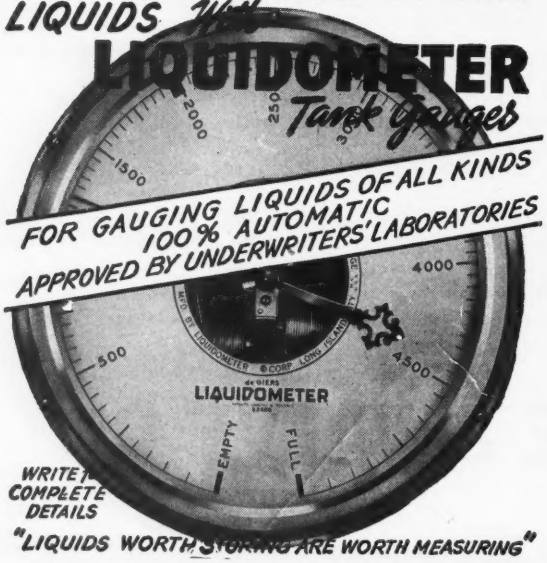
APPROVED BY UNDERWRITERS' LABORATORIES



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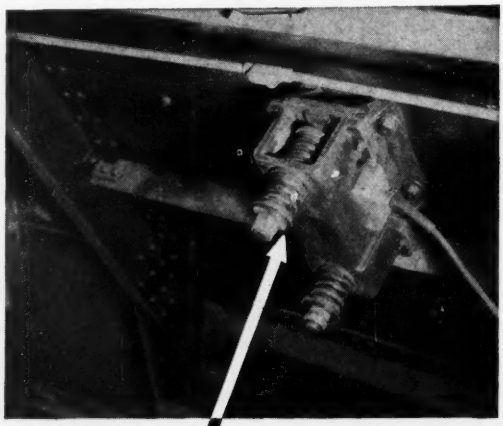
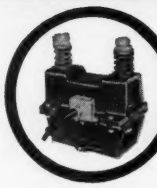
THE LIQUIDOMETER CORP.
36-31 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.





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Eliminate arching and plugging
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a 3 in 1 unit

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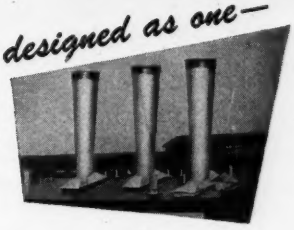
designed as one—



Mounted directly at the boiler outlet, the Thermix Fan-Stack eliminates necessity for expensive stack supporting structure. This installation method also obviates the necessity for the usual type of breeching to stack, to which many costly draft losses can be traced.

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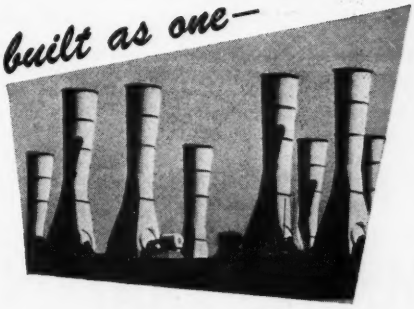
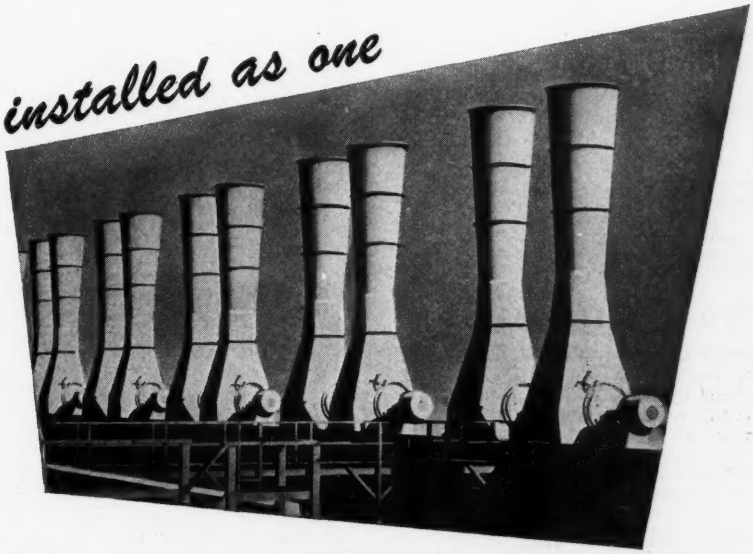


installed as one



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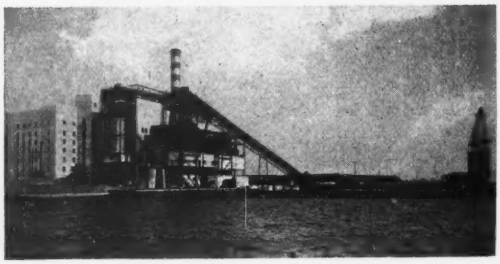

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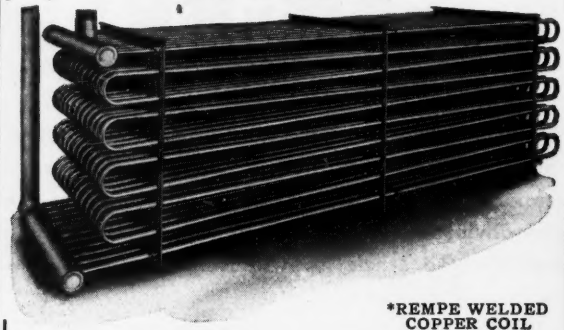

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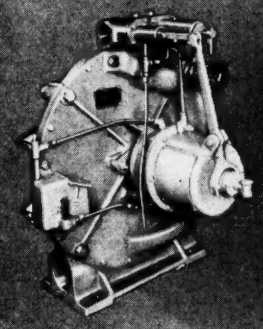

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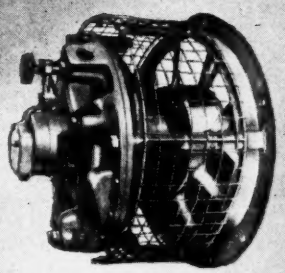

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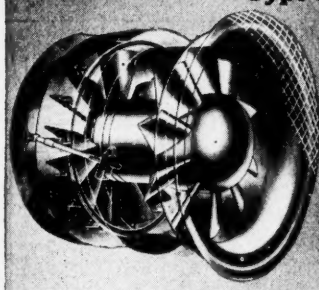
Type EMD (Single Stage)



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Revolving Discharge Outlet No. 5

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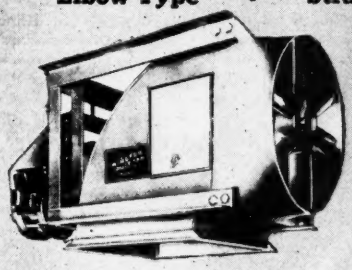
Elbow Type • Straight Line Type



Designed to form a part of any run of duct, or as an elbow in the duct system. Motor and drive are outside air stream, remaining cool, clean and accessible. With "non-overloading" Wingfoil Fan. Consult Bulletin F-9.

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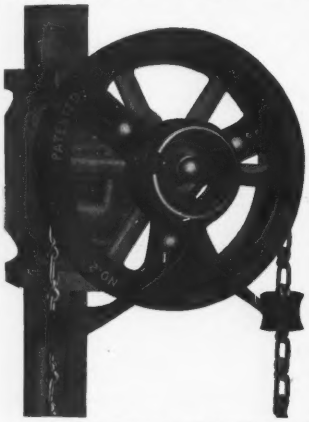

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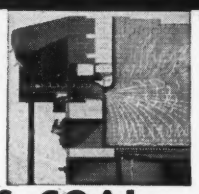

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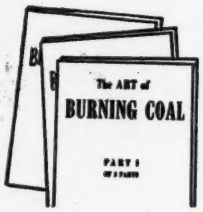

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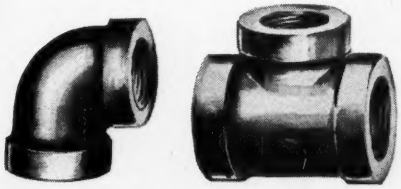

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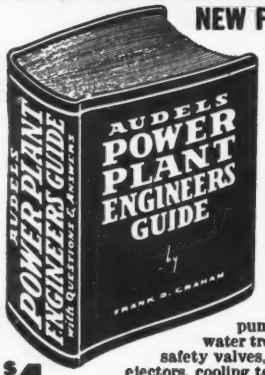

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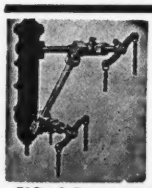

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FIG. 4-F

FIG 13

FIG. 9

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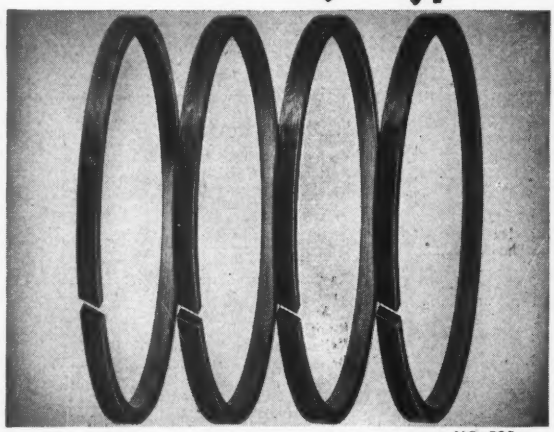

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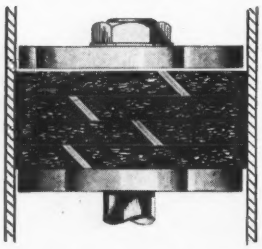

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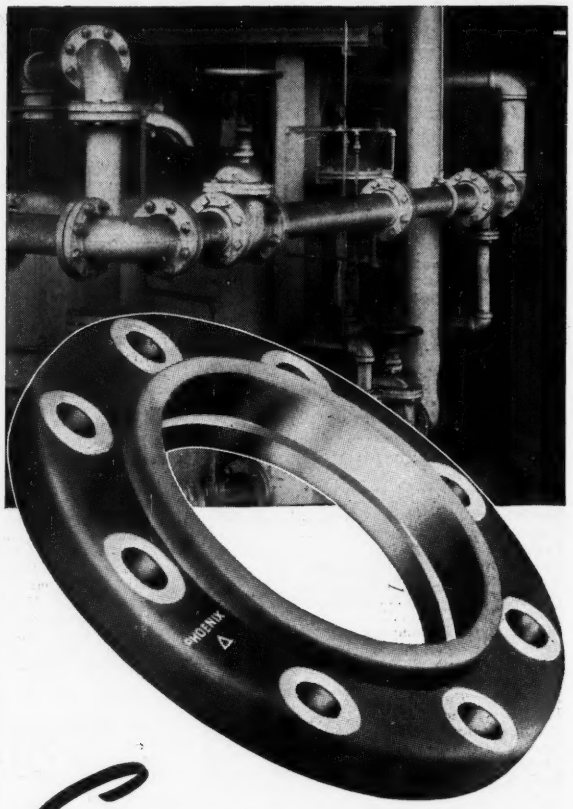

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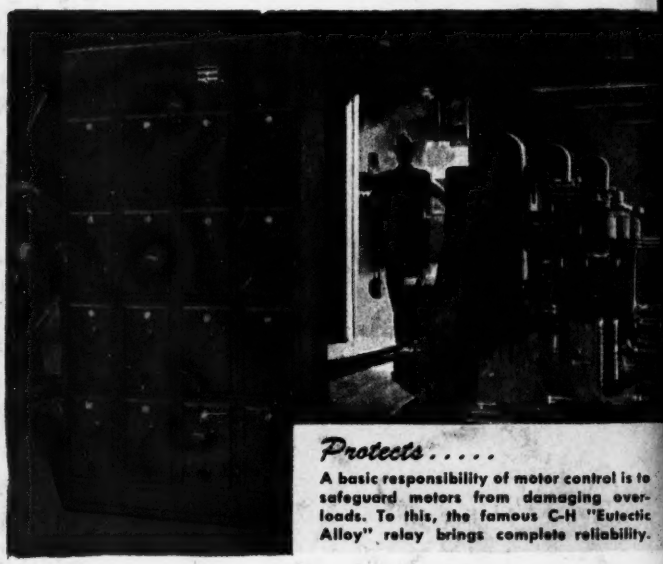

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